BOX NO. 2 FOLDER NO. 5

WAMH/WAMF Records

FCC license test
and study materials

ELEMENT 1
SERIES "O" AND "M"

Question 1. Where and how are FCC licenses and permits obtained? (R&R 13.11(a))

Answer 1. An operator's license or permit may be obtained by applying for a specific license at a regional office of the Federal Communications Commission. An examination must then be taken by the applicant, and if the examination is completed satisfactorily, a license is then issued to the applicant. An applicant for a restricted radiotelephone permit must fill out an application, but he is not required to take an examination.

Q. 2. When a licensee qualifies for a higher grade of FCC license or permit, what happens to the lesser grade license? (R&R 13.26)

A. 2. If the holder of a license qualifies for a higher class in the same group, the license held will be cancelled upon the issuance of the new license. Similarly, if the holder of a restricted operator permit qualifies for a first- or second-class operator license of the corresponding type, the permit held will be cancelled upon issuance of the new license.

Q. 3. Who may apply for an FCC license? (R&R 13.5(a))

A. 3. Normally, commercial licenses are issued only to citizens and other nationals of the United States. As an exception, in the case of an alien who holds an Aircraft Pilot Certificate issued by the Civil Aeronautics Administration or the Federal Aviation Agency and is lawfully in the United States, the Commission, if it finds that the public interest will be served thereby, may waive the requirement of the U. S. nationality.

Q. 4. If a license or permit is lost what action must be taken by the operator? (R & R 13.71, 13.72)

A. 4. He must immediately notify the FCC, and may then apply for a duplicate license. He must inform the Federal Communications Commission of the circumstances surrounding the loss of the original license, or how said license was destroyed. He must state that a reasonable search has been made for the original license, and that if it is found subsequent to the issuance of a duplicate, he will return either the original or the duplicate to the FCC for cancellation. He also must submit documentary evidence of the service performed under the original license.

Pending receipt of the duplicate license, the operator may operate the station, but he must exhibit a signed copy of the application (FCC Form 756) for the duplicate license.

Q. 5. What is the usual license term for radio operators? (R & R 13.4(a))

A. 5. Commercial operator licenses will normally be issued for a term of five years from the date of issuance.

Q. 6. What government agency inspects radio stations in the U.S.? (Sec. 303(n))

A. 6. The Federal Communications Commission.

Q. 7. When may a license be renewed? (R & R 13.11)

A. 7. It may be renewed at any time during the final year of the license term or during a one-year period of grace after the date of expiration of the license sought to be renewed. This is done by submitting Form 756 to the nearest FCC field office. If the renewal application is submitted before the license expires, the operator may continue to operate. However, he must post a duplicate copy of the renewal application in lieu of the original license, since the original license must accompany the application. During the one year period of grace, the expired license is not valid until the new license has been issued.

Q. 8. Who keeps the station logs? (R & R 73.111)

A. 8. Each log shall be kept by the person or persons competent to do so, having actual knowledge of the facts required.

Q. 9. Who corrects errors in the station logs? (R & R 73.111)

A. 9. Any necessary correction may be made only by the person originating the entry.

Q. 10. How may errors in the station logs be corrected? (R & R 3.111)

A. 10. Any necessary correction may be made only by the person originating the entry who shall strike out the erroneous portion, initial the correction made, and indicate the date of correction.

Q. 11. Under what conditions may messages be rebroadcast? (Sec. 325(a))

A. 11. Messages may be rebroadcast only with the express authority of the originating station.

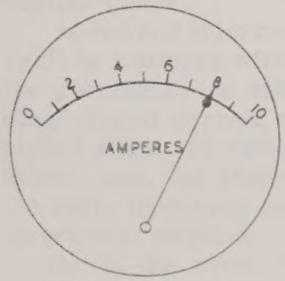
Q. 12. What messages and signals may not be transmitted? (R & R 13.66, 13.67, 13.68)

A. 12. No licensed radio operator shall transmit unnecessary, unidentified, or superfluous radio communications or signals. Neither shall he transmit communications containing obscene, indecent or profane words, language, or meaning. A licensed radio operator is prohibited from transmitting false or deceptive signals or communications by radio, or any call letter or signal which has not been assigned by proper authority to the radio station he is operating.

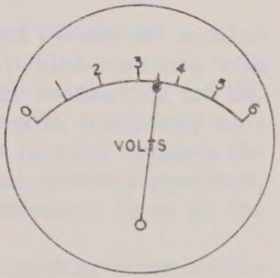
3 milliamperes.

(d) One kilowatt is equal to 1,000 watts. Therefore, in order to change watts to kilowatts, we divide by 1,000. In order to change kilowatts to watts, we multiply by 1,000. Examples: 3.4 kilowatts equals 3,400 watts. 250 watts equals .25 kilowatts.

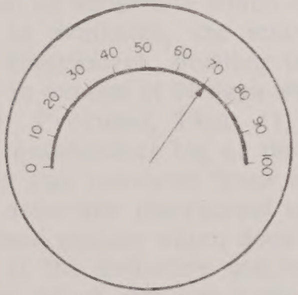
Q. 3. Draw the "face" of the following meters and know how to read each: (a) Ammeter. (b) Voltmeter. (c) Arbitrary scale meter. (d) Frequency monitor meter. (e) VU meter (for % modulation). (f) Milliammeter. (g) Antenna phase meter. (h) RF transmission line power meter.


0
2
4
6
8
10
AMPERES

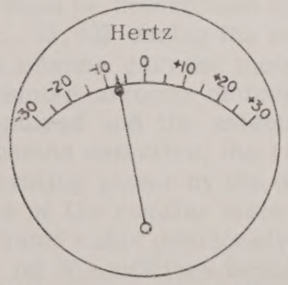
(a) Ammeter. Reading shown is 8 amperes.


0
2
3
4
5
6
VOLTS

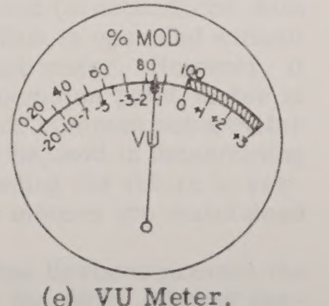
(b) Voltmeter. Reading shown is 3.5 volts.


0
10
20
30
40
50
60
70
80
90
100

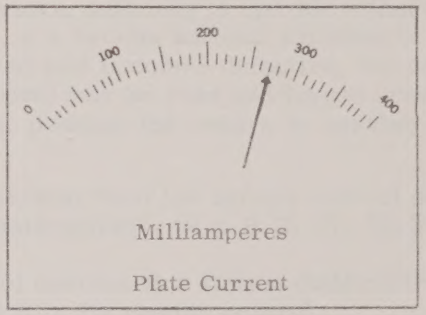
(c) Arbitrary scale meter.


Hertz
-30
-20
-10
0
+10
+20
+30

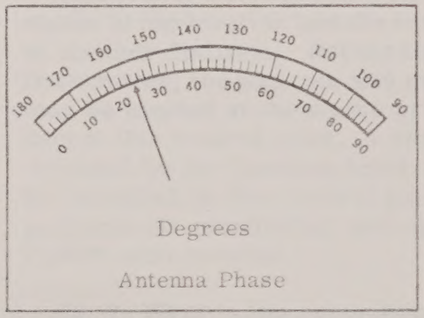
(d) Frequency Monitor Meter indicates deviation in Hertz. (kHz for FM stations) Reading shown is -7 Hertz.


% MOD
0
20
40
60
80
100
-20
-10
-7
-5
-3
-2
-1
0
+1
+2
+3
VU

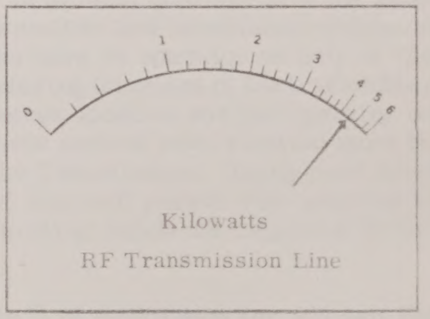
(e) VU Meter. For % modulation, scale is made larger than VU scale. Reading shown is 85% mod.


0
100
200
300
400
Milliamperes
Plate Current

(f) Milliammeter. Reading is 270 ma.


180
170
160
150
140
130
120
110
100
90
0
10
20
30
40
50
60
70
80
90
Degrees
Antenna Phase

(g) Antenna Phase Meter. Reading on bottom scale is 25 degrees.


0
1
2
3
4
5
6
Kilowatts
RF Transmission Line

(h) Transmission Line Wattmeter. Reading is 4.5 kilowatts.

Q. 4. What indicating instruments are found in a broadcast transmitter? What should an operator know about these instruments? (R & R 73.39, 73.58, 73.258, 73.558)

A. Each transmitter is equipped with meters to indicate plate voltage and plate current. These meters indicate the operating constants of the transmitter amplifier. Each transmitter has normal operating levels of plate voltage and plate current and the operator should know what corrective actions should be taken when the meters indicate abnormal values.

At the place in the circuit where the antenna resistance or common point resistance is measured, an antenna ammeter is inserted to measure current into the antenna system. This meter is a direct indication as to whether the station is operating at, above, or below the licensed power. This meter indication should be maintained as close as possible to the licensed operating current and the operator should know what actions are necessary when the meter indications deviate from that value. Usually the antenna ammeter is located at the base of the tower and not easily accessible to the operator on duty. For this reason, most stations use a remote antenna ammeter which is located at the normal operating position of the person on duty. The remote antenna ammeter in-

dication may be entered in the operating log, in lieu of the base current meter indication, provided the remote meter is calibrated once weekly.

All antenna current meters should be read when the transmitter is not being modulated. A break in programs is a good time to read the antenna current meters.

Q. 5. What should an operator do if the remote antenna ammeter becomes defective? (R & R 73.58)

A. If the remote antenna ammeter becomes defective, the antenna base currents may be read and logged once daily for each mode of operation, pending the return to service of the regular remote meter.

Additional information: (a) Each standard broadcast station shall be equipped with indicating instruments (which conform with the specifications set forth in Sec. 73.39) for measuring the DC plate circuit current and voltage of the last radio frequency amplified stage; the radio frequency base current of each antenna element; and, for stations employing directional antenna systems, the radio frequency current at the point of common input to the directional antenna.

(b) In the event that any one of these indicating instruments becomes defective when no substitute which conforms with the required specifications is available, the station may be operated without the defective instrument, pending its repair or replacement, for a period not in excess of 60 days without further authority of the Commission: Provided, That: (1) Appropriate entries shall be made in the maintenance log of the station, showing the date and time the meter was removed from and actually restored to service. (3) If the defective instrument is the antenna current meter of a nondirectional station which does not employ a remote antenna ammeter, or if the defective instrument is the common point meter of a station which employs a directional antenna, and does not employ a remote common point meter, the operating power shall be determined by the indirect method (in accordance with Sec. 73.52) during the entire time the station is operated without the antenna current meter or common point meter. However, if a remote antenna ammeter or a remote common point meter is employed and the antenna current meter or common point meter becomes defective, the remote meter may be used in determining operating power by the direct method, pending the return to service of the regular meter, provided other meters are maintained at same value previously employed.

(c) If conditions beyond the control of the licensee prevent the restoration of the meter to service within the above allowed period, informal request (in accordance with Sec. 1.549) may be filed with the Engineer-in-Charge of the radio district in which the station is located, for such additional time as may be required to complete repairs of the defective instrument.

(d) Remote antenna ammeters and remote common point meters are not required; therefore, authority to operate without them is not necessary. However, if a remote antenna ammeter or common point meter is employed and becomes defective, the antenna base currents (as stated above) may be read and logged once daily for each mode of operation, pending the return to service of the regular remote meter.

Q. 6. What should an operator do if the remote control devices at a station so equipped malfunction? (R & R 73.67, 73.274 and 73.575)

A. If the remote control devices at a station malfunction, the operator should cease operating by remote control.

Additional Information: Some broadcast stations have the main studio at one location and the transmitter and associated equipment at another location. Rather than have an operator on duty at the transmitter, the controls and metering functions of the transmitter may be located at the studio or other location and the operator on duty at this control point. A remote control authorization must be obtained by the licensee from the Commission. Equipment must be installed at the control point that will permit the operator to perform all monitoring and operating functions required by the Commission's rules.

Q. 7. What is the permissible % of modulation for AM and FM stations? (R & R 73.55, 73.268, 73.568)

A. Modulation in excess of 100% is called overmodulation. It is to be avoided because it causes interference in AM and FM transmission. It also causes distortion in AM transmission.

A low percentage of modulation is called undermodulation. Undermodulation is undesirable because it results in weak reception.

In both AM and FM, the percentage of modulation shall be maintained as high as possible, consistent with good quality of transmission and good broadcast practice.

In a standard (AM) broadcast station, the percentage of modulation is not to exceed 100% on negative peaks of frequent recurrence, or 125% on positive peaks at any time.

In FM, the percentage of modulation is not to exceed 100% on either positive or negative peaks of frequent recurrence.

In both AM and FM, the percentage of modulation should not be less than 85% on peaks of frequent occurrence; but where necessary to avoid objectionable loudness, modulation may be reduced to whatever level is necessary, even if the resulting modulation is substantially less than 85% on peaks of frequent occurrence.

Q. 8. What is the station requirement with respect to station monitors? (R& R 73.50, 73.56, 73.253, 73.268, 73.553, 73.568)

A. Each station must have in operation a modulation monitor which the operator uses to determine whether the modulation is at

the proper level. The modulation monitor consists of a meter and a peak flasher. The meter does not indicate the peak modulation, but indicates a value somewhat less than the peak modulation. The "peak flasher" indicates modulation peaks. Generally, the peak flasher is set so that when it flashes, it is an indication that the modulation is excessive and that corrective action must be taken by the operator.

Q. 9. What is the permissible frequency tolerance of standard broadcast stations? (R& R 73.59) Of FM stations? (R& R 73.269)

A. The operating frequency of each AM broadcast station should be maintained within 20 Hertz of the assigned frequency. The center frequency of each FM broadcast station should be maintained within 2,000 Hertz of the assigned center frequency.

Q. 10(a) How is the operating power of a standard broadcast station determined? (R& R 73.51) (b) What is the operating power of a normally operating standard (AM) broadcast station having a final plate voltage of 800 volts, a final plate current of 1000 ma., an antenna resistance of 52 ohms, an antenna current of 3.2 amperes and an F factor of 0.7. (c) How is the operating power of an FM station determined? (R & R 73.267) (d) Using the indirect method, what is the operating power of the above transmitter?

A. (a) (1) Except as provided in paragraph (2) of this section, the operating power shall be determined by the direct method (the square of the antenna current times the antenna resistance at the point where the current is measured and at the operating frequency). For example, if the antenna current is 4.2 amperes and the antenna resistance is 48 ohms, the operating power is:

$$4.2^2 \times 48 = 4.2 \times 4.2 \times 48 = 846.7 \text{ watts}$$

Non-directional AM broadcast stations employ only a single antenna tower. Power determined by the direct method is equal to the product of the antenna resistance and the square of the antenna current. Directional AM broadcast stations employ multiple radiating elements. Power determined by the direct method for these stations is equal to the product of the resistance common to all antenna towers (common point resistance) and the square of the current common to all antenna towers (common point current). At FM broadcast stations, if power is determined by the direct method, it is read directly from the RF transmission line meter. This meter must be calibrated each six months to give a direct indication of the power supplied to the antenna.

(2) Operating power shall be determined on a temporary basis by the indirect method: (i) In the case of an emergency where the licensed antenna system has been damaged by causes beyond the control of the licensee (see Sec. 73.45), or (ii) Pending completion of authorized changes in the antenna system, or (iii) If any change is made in the antenna system or any other change is made which may affect the antenna system. (See Sec. 73.45).

In the indirect method, the operating power or antenna power is found by the formula:

$$P = E_p \times I_p \times F.$$

where: E_p = plate voltage of last stage in volts, I_p = total plate current of last stage in amperes and F = efficiency factor. The efficiency factor is either given by the transmitter manufacturer or by a table in the Rules and Regulations (73.51).

For example, the operating power of a transmitter (using the indirect method), having a plate voltage of 2.8 kv, a plate current of 850 ma. and an "F" factor of .65, is:

$$2800 \text{ V} \times .85 \text{ A} \times .65 = 1547 \text{ watts or } 1.547 \text{ kw.}$$

Note that the voltage must be in volts and the current must be in amperes in order to use the formula properly.

(b) Since the direct method must be used, we used the power formula involving the antenna current (I) and the antenna resistance (R):

$$P = I^2R = (3.2)^2 \times 52 = 3.2 \times 3.2 \times 52 = 532.5 \text{ watts.}$$

(c) The operating power of an FM station is determined by using either the direct or the indirect method. Using the direct method, the power is measured by an RF transmission line meter at the output terminals of the transmitter, while operating into a dummy load of substantially zero reactance and a resistance equal to the transmission line characteristic impedance. The indirect method used for FM stations is the same as that used for AM stations.

(d) Using the indirect method formula, we can find the operating power:

$$P = E_p \times I_p \times F = 800 \times 1 \times .7 = 560 \text{ watts.}$$

Q. 11(a) What stations may be operated by a third class broadcast operator and what equipment adjustments may they perform? (b) What should be the normal operating position of a radio operator? (R & R 73.93, 73.265, 73.565)

A. Except for a very limited number of standard broadcast stations, using critical directional antenna arrays, licensees of AM and FM broadcast stations may employ third class operators for the routine station operations. However, if a station licensee elects to use third class operators, he is subject to many additional requirements. In most cases, a supervisory operator holding a Radiotelephone First-Class Operator's license must be employed either on a full-time or part-time basis.

The third class operator privileges do not include operation of television stations.

With the exceptions set forth below, adjustments of the transmitting system, inspection, maintenance, repairs, required equipment performance measurements and required field strength measurements must be performed only by a first-class radiotelephone

operator.

Except at times when the operation of the station is under the immediate supervision of an operator holding a valid radiotelephone first-class operator license, adjustments of the transmitting equipment by a third class operator shall be limited to the following:

(1) Those necessary to turn the transmitter on and off.

(2) Adjustments of external controls as may be required to compensate for voltage fluctuations in the power supply.

(3) Adjustments of external controls to maintain modulation of the transmitter within the prescribed limits.

(4) Adjustments of external controls necessary to effect routine changes in operating power which are required by the station's instrument of authorization.

(5) Adjustments of external controls necessary to effect operation in accordance with a National Defense Emergency Authorization during an Emergency Action Condition.

(6) Those necessary to change between nondirectional and directional or between differing radiation patterns, provided that such changes require only activation of switches and do not involve the manual tuning of the transmitter final amplifier or antenna phasor equipment. The switching equipment shall be so arranged that the failure of any relay in the directional antenna system to activate properly will cause the emissions of the station to terminate.

It shall be the responsibility of the licensee to insure that the person who may be required to perform these tasks, as well as to perform other duties (such as reading meters and making log entries) is properly instructed so as to be capable of performing the duties required of him at times when not under the immediate supervision of a radiotelephone first-class operator. Where necessary, printed step-by-step instructions shall be posted for those transmitter adjustments which the lesser grade operator is authorized to make. Should the transmitting apparatus be observed to be operating in any manner inconsistent with this subpart or the current instrument of authorization for the station at any time when an operator holding a valid radiotelephone first-class operator license is not immediately available, and none of the above adjustments is effective in correcting the condition of improper operation, the emissions of the station shall be immediately terminated.

(b) One or more operators holding a radio operator license or permit of a grade specified in this section, shall be in actual charge of the transmitting system, and shall be on duty either at the transmitter location or at the remote control point. If operation by remote control has not been authorized, the transmitter, required monitors and other required metering equipment, shall be readily accessible and located sufficiently close to the operator at the normal operating position that deviations from normal indications of required instruments can be observed within a 360° arc from that position. If operation by remote control is authorized, the required controls and instruments shall be readily accessible, and located sufficiently close to the operator at the normal operating position that deviations from normal indications of required metering instruments can be observed in a 360° arc from that position.

Q. 12. What are the power limitations on broadcast stations? (R & R 73.52)

A. The actual antenna input power of each station shall be maintained as near as is practicable to the authorized antenna input power and shall not be less than 90 percent nor greater than 105 percent of the authorized power; except that, if, in an emergency, it becomes technically impossible to operate with the authorized power, the station may be operated with reduced power for a period of 10 days, or less, without further authority from the Commission. If causes beyond the control of the permittee or licensee prevent restoration of authorized power within the allowed period, informal written request shall be made to the Commission in Washington, D. C., no later than the 10th day for such additional time as may be deemed necessary.

Noncommercial educational FM broadcast stations licensed to operate with transmitter output power of 10 watts or less, may be operated at less than the authorized power, but not more than 105 percent of the authorized power.

Q. 13. What logs must be kept by broadcast stations according to the Rules and Regulations of the FCC? (R & R 73.111)

A. The licensee or permittee of each standard broadcast station shall maintain program, operating and maintenance logs. The logs shall be kept in an orderly and legible manner, in suitable form, and in such detail that the data required for the particular class of station concerned is readily available. Time entries shall be either in local standard or daylight saving time and shall be indicated accordingly. Each log sheet shall be numbered and dated. No log or preprinted log or schedule which becomes a log, or portion thereof, shall be erased, obliterated, or willfully destroyed within the period of retention provided by the provision of this part. Any necessary correction shall be made only pursuant to Sections 73.112 and 73.113, and only by striking out the erroneous portion, or by making a corrective explanation on the log or attachment to it, as provided in those sections. Entries shall be made in the logs as required by Sections 73.112 and 73.113.

The operating log and the maintenance log may be kept individually on the same sheet in one common log, at the option of the permittee or licensee.

Q. 14. Who keeps the logs? (R & R 73.111)

A. Each log shall be kept by the station employee or employees (or contract operator) competent to do so, having actual knowledge of the facts required, who in the case of program and operating logs, shall sign the appropriate log when starting duty, and again when going off duty.

Q. 15. What entries are made in the program log? (R & R 73.112) In the operating log? (R & R 73.113)

A. The following entries shall be made in the program log:

(1) For each program: an entry identifying the program by name or title, an entry of the time each program begins and ends, an entry classifying each program as to type (news, religious, entertainment, sports), an entry classifying each program as to source, an entry for each program presenting a political candidate showing the name and political affiliation for such candidate.

(2) For commercial matter: an entry identifying the sponsor(s) of the program, the person(s) who paid for the announcement, or the person(s) who furnished materials or services of any kind (such as records, transcriptions, talent, scripts, etc.), an entry showing the total duration of commercial matter in each hourly time segment (beginning on the hour) or the duration of each commercial message (commercial continuity in sponsored programs, or commercial announcements) in each hour, and an entry showing that the appropriate announcements (sponsorship, furnishing material, or services, etc.) have been made. A check-mark (✓) will suffice but shall be made in such a way as to indicate the matter to which it relates.

(3) For Public service announcements: an entry showing that a public service announcement has been broadcast, together with the name of the organization or interest on whose behalf it has been made.

(4) For other announcements: an entry of the time that each station identification is made (call letters and licensed location), an entry for each announcement presenting a political candidate showing the name and political affiliation of such candidate, an entry showing that a mechanical reproduction announcement has been made. The licensee, whether employing manual or automatic logging, or a combination thereof, must be accurately able to furnish the Commission with all information required to be logged.

Manually kept log. Where, in any program log, or preprinted program log, or program schedule which upon completion is used as a program log, a correction is made before the person keeping the log has signed the log upon going off duty, such correction, no matter by whom made, shall be initialed by the person keeping the log prior to his signing of the log when going off duty, as attesting to the fact that the log, as corrected, is an accurate representation of what was broadcast. If corrections or additions are made on the log after it has been so signed, explanation must be made on the log or on an attachment to it, dated and signed by either the person who kept the log, the station program director or manager, or an officer of the licensee.

An FM station, operating under a Subsidiary Communications Authorization (SCA), should include in the log, at least once a day, a general description of the program content. Any changes in the program content and times of changes, should also be logged.

The following entries shall be made in the operating log by the properly licensed operator in actual charge of the transmitting apparatus, or by automatic devices. (See (b) below.)

(1) An entry of the time the station begins to supply power to the antenna and the time it stops. (2) See Answer 26.

(3) An entry at the beginning of operation in each mode and at intervals not exceeding three hours, of the following (actual readings observed prior to making any adjustments to the equipment) and, when appropriate, an indication of corrections made to restore parameters to normal operating values: (i) Operating constants of last radio stage (total plate voltage and plate current). (ii) Antenna current or common point current (if directional) without modulation.

(4) An entry each day of the following where applicable: (i) Antenna base current(s) without modulation for each mode of operation: (a) Where remote antenna meters or a remote common point meter are normally employed but are defective. (b) Where required by the station license for directional antenna operation. (ii) Where there is remote control operation of a directional antenna station, readings for each pattern taken at the transmitter (within two hours of commencement or operation with each pattern) of: (a) Common point current without modulation. (b) Base current(s) without modulation. (c) Phase monitor sample loop current(s) without modulation. (d) Phase indications.

(5) Any other entries required by the instrument of authorization or the provisions of this part.

(6) The entries required by Section 17.49 and (c) of this chapter. (b) Automatic devices accurately calibrated and with appropriate time, date and circuit functions may be utilized to record the entries in the operating log: Provided, That: (1) They do not affect the operation of circuits or accuracy of indicating instruments of the equipment being recorded; (2) The recording devices have an accuracy equivalent to the accuracy of the indicating instruments; (3) The calibration is checked against the original indicators at least once a week and the results noted in the maintenance log; (4) Provision is made to actuate automatically an aural alarm circuit located near the operator on duty, if any of the automatic log readings are not within the tolerances or other requirements specified in the rules or instrument of authorization; (5) Devices which record each parameter in sequence must read each parameter at least once during each 10-minute period and clearly indicate the parameter being recorded; (6) The automatic logging equipment is located at the remote control point if the transmitter

is remotely controlled, or at the transmitter location if the transmitter is manually controlled; (7) The automatic logging equipment is located in the near vicinity of the operator on duty and is inspected by him periodically during the broadcast day; and (8) The indicating equipment conforms with the requirements of Sec. 73.39 except that the scales need not exceed 2 inches in length and arbitrary scales may not be used.

Manually kept log. Any necessary corrections in a manually kept operating log shall be made only by the person making the original entry who shall make and initial each correction prior to signing the log when going off duty, in accordance with 73.111(a). If corrections or additions are made on the log after it has been so signed, explanation must be made on the log or on an attachment to it, dated and signed by either the operator who kept the log, the station technical supervisor or an officer of the licensee.

FM stations, using the direct method of determining power, log the RF transmission line meter reading rather than the antenna current, as in AM stations.

An FM station operating under a Subsidiary Communications Authorization must keep a log of its operation. The log may be included as part of the operating log for the main channel or may be kept separately. Entries are required of the time the subcarrier generator is turned on and when it is turned off (excluding subcarrier interruptions of 5 minutes or less). An entry is also required for the time modulation is applied to the subcarrier and the time the modulation is removed from the subcarrier.

FM broadcast stations with an operating power of 10 watts or less are only required to log the time the station begins to supply power to the antenna, the time it stops, and entries concerning the daily observations of tower lights.

Q. 16. When may abbreviations be used in the station's logs? (R & R 73.111)

A. Key letters or abbreviations may be used if proper meaning or explanation is contained elsewhere in the log.

Q. 17. How may a station's logs be corrected?(R & R 73.111).

A. Any necessary correction to a station's logs may be made by striking out the erroneous portion, initialing the correction made, and indicating the date of correction. Also, see Answer 15 above.

Q. 18. According to the Rules and Regulations of the FCC, how long must station logs be retained? (R & R 73.115)

A. Logs of standard broadcast stations shall be retained by the licensee or permittee for a period of two years: Provided, however, That logs involving communications incident to a disaster or which include communications incident to or involved in an investigation by the Commission and concerning which the licensee or permittee has been notified, shall be retained by the licensee or permittee until he is specifically authorized in writing by the Commission to destroy them: Provided, further, That logs incident to or involved in any claim or complaint of which the licensee or permittee has notice, shall be retained by the licensee or permittee until such claim or complaint has been fully satisfied, or until the same has been barred by statute limiting the time for the filing of suits upon such claims.

Q. 19. What information must be given to an FCC inspector at any reasonable hour? (R & R 73.116)

A. The following shall be made available upon request by an authorized representative of the FCC: (a) Program, operating and maintenance logs. (b) Equipment performance measurements required by Sec. 73.47. (c) Copy of most recent antenna resistance or common-point impedance measurements submitted to the Commission. (d) Copy of most recent field intensity measurements to establish performance of directional antennas required by Sec. 73.151.

The above information must be made available for inspection by representatives of the FCC at any reasonable hour.

Q. 20. What must be included in a station identification and how often is it given? (R & R 73.1201)

A. Station identification shall consist of the station's call letters, immediately followed by the name of the community or communities, specified in its license as the station's location.

These identification announcements must be made: (1) At the beginning (sign-on) and ending (sign-off) of each time of operation, and (2) hourly, as close to the hour as feasible, at a natural break in program offerings. Television broadcast stations may make these announcements visually or aurally. The only legal requirement for "sign-on" or "sign-off" is the correct station identification.

Q. 21. What should an operator do if the modulation monitor becomes defective? (R & R 73.56)

A. (a) Each station shall have in operation, either at the transmitter or at the place the transmitter is controlled, a modulation monitor of a type approved by the Commission. (b) In the event that the modulation monitor becomes defective, the station may be operated without the monitor, pending its repair or replacement, for a period not in excess of 60 days without further authority of the Commission: Provided, That: (1) Appropriate entries shall be made in the maintenance log of the station showing the date and time the monitor was removed from and restored to service.
(3) The degree of modulation of the station shall be monitored with a cathode ray oscilloscope or other acceptable means.

Q. 22. When should minor corrections to the transmitter be made? Before or after logging the meter readings? (R & R 73.113)

A. Minor corrections to the transmitter should be made after

logging the meter readings.

Q. 23. What must a broadcast station do when it transmits matter for which it receives compensation? (R & R 73.119 and 73.289)

A. When a broadcast station transmits matter for which it receives or expects to receive any compensation such as money, services, or other consideration, the station must announce that the matter is sponsored or furnished and also announce the name of the sponsor. However, when a commercial product or service is advertised, use of the sponsor's corporate name, trade name, or name of the product or service will suffice if it is clear that the product name identifies the sponsor. Broadcast station licensees are responsible to insure that their employees or others connected with program material are fully aware that accurate sponsor identification must be obtained and broadcast. Sponsored programs and announcements that do not promote a specific commercial service or product must also be identified by the name of the actual sponsor. Operators keeping program logs must be alert to insure that sponsored matter is announced at the time of the broadcast and the sponsor is correctly identified in the program log.

Q. 24. When should an operator announce a program as "recorded? (R & R 73.1208)

A. Any taped, filmed or recorded program material in which time is of special significance, or by which an affirmative attempt is made to create the impression that it is occurring simultaneously with the broadcast, shall be announced at the beginning as taped, filmed or recorded. The language of the announcement shall be clear and in terms commonly understood by the public. For television stations, the announcement may be made visually or aurally.

Taped, filmed or recorded announcements which are of a commercial, promotional or public service nature, need not be identified as taped, filmed or recorded.

Q. 25. How often should the tower lights be checked for proper operation? (R & R 17.47 and 17.98)

A. Once each day, the operator is required to check for the proper operation of the tower lighting system. Most tower lighting systems are turned on and off with an automatic actuation switch controlled by a photocell. Stations using the photocell are required to burn the lights continuously if the automatic actuation switch does not operate properly. Any observed or otherwise known outage or improper functioning of a code or rotating beacon light or top light not corrected in 30 minutes should be reported by telephone or telegraph to the nearest Flight Service Station or office of the Federal Aviation Administration. Notice should also be given to the Flight Service Station or FAA office when the situation has been corrected.

Q. 26. What record is kept of tower light operation? (R & R 17.49)

A. The licensee of any radio station which has an antenna structure requiring illumination, shall make the following entries in the station record of the inspections:

(a) The time the tower lights are turned on and off each day, if manually controlled;

(b) The time the daily check of proper operation of the tower lights was made, if automatic alarm system is not provided;

(c) In the event of any observed or otherwise known failure of a tower light: (1) Nature of such failure. (2) Date and time the failure was observed, or otherwise noted. (3) Date, time and nature of the adjustments, repairs or replacements made. (4) Identification of Flight Service Station (Federal Aviation Agency) notified of the failure of any code or rotating beacon light or top light not corrected within 30 minutes, and the date and time such notice was given. (5) Date and time notice was given to the Flight Service Station (Federal Aviation Agency) that the required illumination was resumed.

(d) Upon completion of the periodic inspection required at least once each three months: (1) The date of the inspection and the condition of all tower lights and associated tower lighting control devices, indicators and alarm systems. (2) Any adjustments, replacements or repairs made to insure compliance with the lighting requirements, and the date such adjustments, replacements or repairs were made.

Q. 27. What is an Emergency Action Notification? (EAN) (R & R 73.907)

A. The Emergency Action Notification is the notice (with or without an Attack Warning) to all licensees and regulated services of the Federal Communications Commission and to the general public, of the existence of an Emergency Action Condition. The Emergency Action Notification is released upon direction of the President of the United States, and is disseminated only via the Emergency Action Notification System.

Q. 28. What is an Emergency Action Condition? (R & R 73.908)

A. An Emergency Action Condition is the condition which exists after the transmission of an Emergency Action Notification and before the transmission of the Emergency Action Termination. It is actually a national, state or local area emergency situation posing a threat to the safety of life or property.

Q. 29. What equipment must be installed in broadcast stations in regard to reception of an Emergency Action Notification? (R & R 73.933)

A. (a) All broadcast station licensees must install and oper-

ate, during their hours of broadcast operation, equipment capable of receiving Emergency Action Notifications or Terminations transmitted by other radio broadcast stations. This equipment must be maintained in operative condition, including arrangements for human listening watch or automatic alarm devices, and shall have its termination at each transmitter control point. However, where more than one broadcast transmitter is controlled from a common point by the same operator, only one set of equipment is required at that point.

(b) The off-the-air monitoring assignment of each standard, FM and television broadcast station is specified in the Detailed State Emergency Broadcast System (EBS) Operational Plan. Particular attention should be paid to avoiding "closed loops" in monitoring assignments.

(c) Prior to commencing routine operation or originating any emissions under program test, equipment test, experimental, or other authorizations or for any other purpose, licensees or permittees shall first ascertain whether an Emergency Action Condition exists and, if so, shall operate only in accordance with the Basic Emergency Broadcast System (EBS) Plan and Detailed State Emergency Broadcast System (EBS) Operational Plan.

Q. 30. How often should EBS test transmissions be sent? During what time period are they sent? (R & R 73.910, 73.961)

A. EBS test transmissions of the Emergency Action Notification System will be conducted by standard, FM and television broadcast stations once each week on an unscheduled basis, between the hours of 8:30 A.M. and local sunset. These tests will be conducted in accordance with procedures set forth in the EBS check list furnished to all broadcast stations.

Q. 31. During a period of an Emergency Action Condition, what should all non-participating stations do? (R & R 73.932(a))

A. Non-participating stations must observe radio silence.

Q. 32. (a) What is meant by the term "rebroadcast"? (b) What is the rule regarding the rebroadcasting of a program of another broadcasting station? (R & R 73.1207)

A. (a) The term "rebroadcast" means reception by radio of the programs of a radio station, and the simultaneous or subsequent retransmission of such programs by a broadcast station.

(b) No broadcasting station shall rebroadcast the program, or any part thereof, of another broadcasting station without the express authority of the originating station. A copy of the written consent, of the licensee originating the program shall be kept by the licensee of the station rebroadcasting such program, and shall be made available to the Commission upon request.

Q. 33. What are the rules with regard to broadcasting lottery information? (R & R 73.1211)

A. Broadcast stations are prohibited from transmitting announcements or programs promoting or containing information that would promote lotteries. A lottery is any scheme in which money or a prize of value is awarded to a person selected by lot or chance, if a condition of winning is that a person must have furnished any money, purchased a product or service, or have in his possession a product sold by the sponsor of a program broadcast on the station in question.

The provisions stated above do not apply to a lottery conducted by a State acting under authority of State law when such information is broadcast: (1) by a radio or television broadcast station licensed to a location in that State, or (2) by a radio or television broadcast station licensed to a location in an adjacent State which also conducts such a lottery. Such State "lottery" means the pooling of proceeds derived from the sale of tickets or chances and allotting those proceeds or parts thereof by chance to one or more chance takers or ticket purchasers. It does not include the placing or accepting of bets or wagers on sporting events or contests.

Q. 34. If a license or permit is lost, what action must be taken by the operator? What is the usual license term for radio operators? When may a license be renewed? (R & R 13.4, 13.11, 13.71 and 13.72)

A. See answers to Questions 4, 5 and 7 of Element 1, Series "O" and "M".

Q. 35. Where does an operator post his permit? (R & R 73.92, 73.264 and 73.564)

A. The operator must post his permit or posting statement at the place where he is on duty at the transmitter control point. FCC Form 759 is a posting statement used by operators employed at more than one station. The permit is posted at one station and FCC Forms 759 are posted at other stations where the operator is employed. The station license and other operating authorizations must be posted at the transmitter control point with all terms visible.

Q. 36. What is the rule regarding the broadcasting of a telephone conversation? (R & R 73.1206)

A. Before broadcasting a telephone conversation or recording a telephone conversation for later broadcast, the parties to the conversation must be informed of the intention to broadcast the conversation. However, station employees who may be presumed to be aware that their telephone conversations are intended for broadcast are not required to be advised of the broadcasting of their calls. Also, no notice of broadcast is required for per-

sons originating calls to programs which normally broadcast telephone conversations coming into the program.

Q. 37. What is a Subsidiary Communications Authorization? For what purpose is it used? (R & R 73.293, 73.295, 73.297, 73.593, 73.595 and 73.596)

A. A Subsidiary Communications Authorization (SCA) is a permit to use a subchannel within the main FM channel assignment.

In addition to monaural operation, FM stations may elect to broadcast stereo programming. This is accomplished by inserting a subchannel within the FM channel. In addition to the stereophonic subchannel, an entirely different subchannel may also be used. Programs transmitted by way of the Subsidiary Communications Authorization cannot be received without a special multiplex receiver. Most SCA subcarriers are used for the transmission of subscription background music, such as the music that is broadcast to stores and factories by Muzak. Other SCA uses are for detailed weather forecasting, special time signals, and other material of a broadcast nature expressly designed and intended for business, professional, educational, religious, trade, labor, agriculture or other groups engaged in any lawful activity.

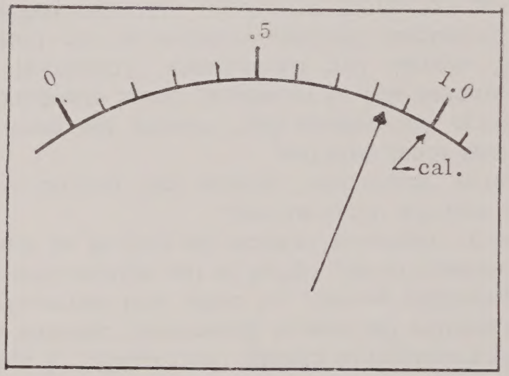
Q. 38(a) What is the basic difference between directional antenna systems and non-directional antenna systems? (b) How does the radio operator determine that a directional antenna is radiating according to a specified pattern? (c) Discuss phase differences and current ratios with respect to directional antenna systems. (R & R 73.69, 73.95)

A. (a) Non-directional AM stations use a single antenna tower and transmit the radio signal with equal strength in all directions from the station. Directional AM stations utilize more than one antenna tower. By establishing the position of each tower, the power radiated by each tower, and the phase of the signal in each tower, different signal strengths can be radiated in various directions. Directional antenna systems are used to improve the signal over desired areas and to reduce the signal in the direction of other stations to prevent interference.

(b) To determine if a directional antenna system is radiating the signal according to a specified radiation pattern, an instrument called an antenna monitor is installed at the station. The antenna monitor enables the operator to determine if the radio frequency (RF) current in each tower is of the correct value and if the phase of the signal radiated by each tower is also correct. Some antenna monitors indicate the ratio of current in each tower to the current in one tower called the reference tower.

(c) A radio frequency signal or current is actually an alternating current. In addition to reversing itself continuously, its actual instantaneous value is varying from zero to a certain amount. If the instantaneous peak values of the signals arrive at each tower at the exact same time, we say that the currents in each tower are "in phase" with each other. If the instantaneous peak values of the signals do NOT arrive at the towers at the exact same time, we say that the currents are "out of phase" with each other. The difference in time or phase is measured in degrees.

In most directional antenna systems, the currents in the various towers are out of phase with each other. The actual antenna currents (as read by ammeters), also tend to be different from each other. For each directional antenna tower, the station license contains a list of the required signal phases and antenna base current ratios. The antenna base current ratio for a tower is calculated by dividing the current meter reading for that tower by the current meter reading for the designated reference tower. The ratio, either calculated or read on the antenna monitor (see figure below), must not deviate more than 5 percent from the value on the station license. Operators on duty at AM stations, using directional antenna systems, should know how to read the antenna monitor meters, and should know how to use charts, tables or other instructions to determine if the station is operating correctly, if attention by the station's first class operator is required, or if the station must terminate operation.



Basic Antenna Current Ratio Meter.

The meter is set for "1.0" (cal.) by reading the current in the designated reference tower. The current is then taken for a given tower and its current ratio is then read on the meter. The meter can be in percentage or ratio. The above meter reads a ratio of .85.

tion utilizing the main channel and a stereophonic subchannel.

(g) An "FM Subsidiary Communications Authorization" (SCA) is an authorization granted to an FM station for the simultaneous transmission of one or more signals on assigned subcarrier frequencies within the station's assigned channel. Special decoding equipment is required to receive program material furnished on the SCA subchannel. Such material, although broadcast related, is normally intended for paying subscribers.

(h) The terms "sunrise" and "sunset" mean, for each particular location and during any particular month, the time of sunrise and sunset as specified in the instrument of authorization. Specifying the times of sunrise and sunset on the station license is important because not all standard (AM) broadcast stations are permitted to operate at night. In order to control objectionable sky-wave interference, stations which are permitted to operate at night are frequently required to change their modes of operation. These changes may involve the use of directional antenna systems, a reduction in operating power, or both, and normally occur at the sunrise and sunset times, listed in the station license.

(i) The term "daytime" means the period of time between the local sunrise and the local sunset.

(j) The term "nighttime" means that period of time between local sunset and local sunrise.

(k) The term "broadcast day" means the period of time between local sunrise and 12 midnight, local standard time.

(l) "EBS" stands for Emergency Broadcast System. The Emergency Broadcast System consists of the facilities and personnel of nongovernment broadcast stations and interconnecting facilities which have been authorized by the Federal Communications Commission to operate in a controlled manner during a war, threat of war, state of public peril or disaster, or other national emergency.

(m) The "attention signal" is the signaling arrangement whereby standard, FM and television broadcast stations can actuate mute receivers for interstation receipt of emergency cueing announcements and broadcasts. It consists of two audio tones having fundamental frequencies of 853 and 960 Hertz and shall not vary over ±0.5 Hertz. The two tones, with specified frequency tolerances and harmonic distortion limits, modulate the transmitter simultaneously at no less than 40% for an automatic time period of not less than 20 seconds, nor longer than 25 seconds.

The total harmonic distortion of each of the audio tones shall not exceed 5%.

(n) "Nominal power" is the power of a standard broadcast station, as specified in a system of classification which includes the following values: 50 kW., 25 kW., 10 kW., 5 kW., 1 kW., 0.5 kW., 0.25 kW.

(o) Depending on the context within which it is employed, the term "operating power" may be synonymous with "nominal power" or "antenna power". The operating power for AM stations is normally the antenna input power and for FM stations, it is the transmitter output power.

(p) "Maximum rated carrier power" is the maximum power at which the transmitter can be operated satisfactorily, and is determined by the design of the transmitter and the type and number of vacuum tubes used in the last radio stage.

(q) "Plate input power" means the product of the direct plate voltage applied to the tubes in the last radio stage, and the total direct current flowing to the plates of these tubes, measured without modulation.

(r) "Antenna input power" or "antenna power" means the product of the square of the antenna current and the antenna resistance at the point where the current is measured.

(s) "Antenna current" means the radio-frequency current in the antenna with NO MODULATION.

(t) "Antenna resistance" means the total resistance of the transmitting antenna system at the operating frequency and at the point at which the antenna current is measured.

(u) "Percentage modulation" with respect to an amplitude modulated wave means the ratio of half the difference between the maximum and minimum amplitudes of the amplitude modulated wave to the average amplitude expressed in percentage.

Q. 2. Make the following transformations:

(a) Kilocycles to cycles.
(b) Kilovolts to volts.
(c) Milliamperes to amperes.
(d) Watts to kilowatts.

A. 2(a) One kilocycle (kc) is equal to 1,000 cycles (c). Therefore, in order to change kilocycles to cycles, we multiply by one thousand. In order to change cycles to kilocycles, we divide by one thousand. Examples: 3 kilocycles equals 3,000 cycles. 1.4 kilocycles equals 1,400 cycles. 500 cycles equals .5 kilocycle.

In recent years, the electronics industry has adopted the term "Hertz", abbreviated "Hz", to replace the term "cycles". Kilocycles has been replaced by "kiloHertz", abbreviated "kHz"; megacycles (meaning one million cycles), has been replaced by "MegaHertz", abbreviated "MHz".

(b) One kilovolt is equal to 1,000 volts. Therefore, in order to change kilovolts (kv) to volts (v), we multiply by one thousand. In order to change volts to kilovolts, we divide by one thousand. Examples: 2.6 kilovolts equals 2,600 volts. 1 kilovolt equals 1,000 volts. 50 volts equals .050 kilovolt.

(c) One ampere is equal to 1,000 milliamperes. Therefore, in order to change milliamperes (ma.) to amperes (A), we divide by one thousand. In order to change amperes to milliamperes, we multiply by one thousand. Examples: 50 milliamperes equals .050 ampere. 200 milliamperes equals .2 ampere. .003 ampere equals

ELEMENT 9*

Question 1. What is meant by the following words or phrases?

(a) Standard broadcast station (AM) (R & R 73.1)
(b) Standard broadcast band (R & R 73.2)
(c) Standard broadcast channel (R & R 73.3)
(d) FM station (R & R 73.310)
(e) FM band (R & R 73.310)
(f) FM Stereophonic Broadcast (R & R 73.310)
(g) FM Subsidiary Communications Authorization (SCA) (R & R 73.293)
(h) Sunrise and Sunset (R & R 73.8)
(i) Daytime (R & R 73.6)
(j) Nighttime (R & R 73.7)
(k) Broadcast day (R & R 73.9)
(l) EBS (R & R 73.912)
(m) Attention signal (R & R 73.906)
(n) Nominal power (R & R 73.14)
(o) Operating power (R & R 73.14)
(p) Maximum rated carrier power (R & R 73.14)
(q) Plate input power (R & R 73.14)
(r) Antenna power (R & R 73.14)
(s) Antenna current (R & R 73.14)
(t) Antenna resistance (R & R 73.14)
(u) Percentage modulation (amplitude) (R & R 73.14)

Answer 1(a). The term "standard broadcast station" (AM) means a broadcasting station licensed for the transmission of amplitude-modulated (voice type) emissions primarily intended to be received by the general public and operated on a channel in the band - 535 kiloHertz to 1605 kiloHertz.

(b) The term "standard broadcast band" means the band of frequencies between 535 kiloHertz and 1605 kiloHertz.

(c) The term "standard broadcast channel" means the band of frequencies occupied by the carrier and two side bands of a broadcast signal with the carrier frequency at the center. Channels shall be designated by their assigned carrier frequencies. The 107 carrier frequencies assigned to standard broadcast stations shall begin at 540 kiloHertz and be in successive steps of 10 kiloHertz.

(d) The term "FM station" means a station employing frequency modulation in the FM broadcast band and licensed primarily for the transmission of radiotelephone emissions intended to be received by the general public.

(e) The term "FM band" means the band of frequencies extending from 88 to 108 megaHertz, which includes those assigned to noncommercial educational broadcasting.

(f) The term "FM Stereophonic Broadcast" means the transmission of a stereophonic program by a single FM broadcast sta-

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*See note in Preface concerning Element 9 examination.

ELEMENT 2 — SERIES "O"

Ques. 1. What should an operator do when he leaves a transmitter unattended?

Ans. 1. Precautions should be taken so that the equipment will not be subjected to use by unauthorized personnel.

Q. 2. What are the meanings of: clear, out, over, roger, words twice, repeat, and break?

A. 2(a). "Clear" indicates that the transmission is completed, and that no response is expected.

(b) "Out" is similar in meaning to "clear". It indicates that the conversation is ended and no response is expected.

(c) "Over" indicates that the transmission has ended and a response is expected.

(d) "Roger" indicates that the immediately preceding message has been received, and is completely understood.

(e) "Words twice" is used to indicate that a series of words will be sent two times due to poor reception conditions or general communications difficulty.

(f) "Repeat" means to say again.

(g) The term "break" is used as a separation between parts of a single message.

Q. 3. How should a microphone be treated when used in noisy locations?

A. 3. It is good practice for the operator to shield the microphone with his hands when speaking into a microphone in a noisy location. This tends to cut down the microphone's picking up of background noise.

Q. 4. What may happen to the received signal when an operator has shouted into a microphone?

A. 4. Shouting into the microphone generally causes overmodulation. This results in speech distortion, as well as interference with stations on adjacent frequencies.

Q. 5. Why should radio transmitters be "off" when signals are not being transmitted?

A. 5. The transmitter should be off to prevent causing interference to other stations on the frequency.

Q. 6. Why should an operator use well-known words and phrases?

A. 6. Simple phrases and plain language are easier to understand. This reduces the number of errors that are made, and minimizes the amount of repetition necessary.

Q. 7. Why is the station's call sign transmitted?

A. 7. A station's call sign is transmitted so as to enable one to identify the station and thus avoid possible confusion. A proper station identification consists of the call letters and location of the station.

Q. 8. Where does an operator find specifications for obstruction marking and lighting (where required) for the antenna towers of a particular radio station?

A. 8. If an operator wishes to determine the specifications for obstruction marking and lighting of antenna towers, he should look in Part 17 of the Rules and Regulations of the FCC. If he wishes to determine the specifications for a particular station, he should examine the station authorization issued by the Commission.

Q. 9. What should an operator do if he hears profanity being used at his station?

A. 9. The licensed operator on duty should endeavor to end the transmission and should enter the relevant details in the log of the station. A report of the incident should be submitted to the FCC.

Q. 10. What should an operator do if the station he is calling does not answer within a reasonable length of time?

A. 10. He should stop calling and wait a reasonable length of time before attempting to call again. Continuous calling without results only causes interference and takes up valuable airways space that could be used by others.

Q. 11. When may an operator use his station without regard to certain provisions of his station license? (R & R 2.405)

A. 11. The licensee of any station, except amateur, may, during a period of emergency in which normal communication facilities are disrupted as a result of hurricane, flood, earthquake or similar disaster, utilize such station for emergency communication service in communicating in a manner other than that specified in the instrument of authorization: Provided: (a) That as soon as possible after the beginning of such emergency use, notice be sent to the Commission at Washington, D. C., and to the Engineer in Charge of the district in which the station is located, stating the nature of the emergency and the use to which the station is being put, and (b) That the emergency use of the station shall be discontinued as soon as substantially normal communication facilities are again available, and (c) That the Commission at Washington, D. C., and the Engineer in Charge shall be notified immediately

WAMH-FM

AMHERST COLLEGE RADIO

Do not write inside

ELEMENT 1
SERIES "O" AND "M"

Question 1. Where and how are FCC licenses and permits obtained? (R&R 13.11(a))

Answer 1. An operator's license or permit may be obtained by applying for a specific license at a regional office of the Federal Communications Commission. An examination must then be taken by the applicant, and if the examination is completed satisfactorily, a license is then issued to the applicant. An applicant for a restricted radiotelephone permit must fill out an application, but he is not required to take an examination.

Q. 2. When a licensee qualifies for a higher grade of FCC license or permit, what happens to the lesser grade license? (R&R 13.26)

A. 2. If the holder of a license qualifies for a higher class in the same group, the license held will be cancelled upon the issuance of the new license. Similarly, if the holder of a restricted operator permit qualifies for a first- or second-class operator license of the corresponding type, the permit held will be cancelled upon issuance of the new license.

Q. 3. Who may apply for an FCC license? (R&R 13.5(a))

A. 3. Normally, commercial licenses are issued only to citizens and other nationals of the United States. As an exception, in the case of an alien who holds an Aircraft Pilot Certificate issued by the Civil Aeronautics Administration or the Federal Aviation Agency and is lawfully in the United States, the Commission, if it finds that the public interest will be served thereby, may waive the requirement of the U. S. nationality.

Q. 4. If a license or permit is lost what action must be taken by the operator? (R & R 13.71, 13.72)

A. 4. He must immediately notify the FCC, and may then apply for a duplicate license. He must inform the Federal Communications Commission of the circumstances surrounding the loss of the original license, or how said license was destroyed. He must state that a reasonable search has been made for the original license, and that if it is found subsequent to the issuance of a duplicate, he will return either the original or the duplicate to the FCC for cancellation. He also must submit documentary evidence of the service performed under the original license.

Pending receipt of the duplicate license, the operator may operate the station, but he must exhibit a signed copy of the application (FCC Form 756) for the duplicate license.

Q. 5. What is the usual license term for radio operators? (R & R 13.4(a))

A. 5. Commercial operator licenses will normally be issued for a term of five years from the date of issuance.

Q. 6. What government agency inspects radio stations in the U.S.? (Sec. 303(n))

A. 6. The Federal Communications Commission.

Q. 7. When may a license be renewed? (R & R 13.11)

A. 7. It may be renewed at any time during the final year of the license term or during a one-year period of grace after the date of expiration of the license sought to be renewed. This is done by submitting Form 756 to the nearest FCC field office. If the renewal application is submitted before the license expires, the operator may continue to operate. However, he must post a duplicate copy of the renewal application in lieu of the original license, since the original license must accompany the application. During the one year period of grace, the expired license is not valid until the new license has been issued.

Q. 8. Who keeps the station logs? (R & R 73.111)

A. 8. Each log shall be kept by the person or persons competent to do so, having actual knowledge of the facts required.

Q. 9. Who corrects errors in the station logs? (R & R 73.111)

A. 9. Any necessary correction may be made only by the person originating the entry.

Q. 10. How may errors in the station logs be corrected? (R & R 3.111)

A. 10. Any necessary correction may be made only by the person originating the entry who shall strike out the erroneous portion, initial the correction made, and indicate the date of correction.

Q. 11. Under what conditions may messages be rebroadcast? (Sec. 325(a))

A. 11. Messages may be rebroadcast only with the express authority of the originating station.

Q. 12. What messages and signals may not be transmitted? (R & R 13.66, 13.67, 13.68)

A. 12. No licensed radio operator shall transmit unnecessary, unidentified, or superfluous radio communications or signals. Neither shall he transmit communications containing obscene, indecent or profane words, language, or meaning. A licensed radio operator is prohibited from transmitting false or deceptive signals or communications by radio, or any call letter or signal which has not been assigned by proper authority to the radio station he is operating.

Q. 13. May an operator deliberately interfere with any radio communication or signal? (R & R 13.69)

A. 13. No.

Q. 14. What type of communication has top priority in the mobile service? (ART.)

A. 14. Distress calls, distress messages and distress traffic have top priority in the mobile service. Urgent signals are next in the order of priority, followed by safety signals.

Q. 15. What are the grounds for suspension of operator licenses? (Sec. 303(m)(1))

A. 15. The FCC may suspend an operator license upon proof sufficient to satisfy the Commission that the licensee:

(a) Has violated any provision of any Act, treaty or convention binding on the United States, which the Commission is authorized to administer, or any regulation made by the Commission under any such Act, treaty, or convention; or

(b) Has failed to carry out a lawful order of the master or person lawfully in charge of the ship or aircraft on which he is employed; or

(c) Has willfully damaged or permitted radio apparatus or installations to be damaged; or

(d) Has transmitted superfluous radio communications or signals or communications containing profane or obscene words, language, or meaning, or has knowingly transmitted ---

(1) False or deceptive signals or communications, or
(2) A call signal or letter which has not been assigned by proper authority to the station he is operating; or

(e) Has willfully or maliciously interfered with any other radio communications or signals; or

(f) Has obtained or attempted to obtain, or has assisted another to obtain or attempt to obtain, an operator's license by fraudulent means.

Q. 16. When may an operator divulge the contents of an intercepted message? (Sec. 605)

A. 16. An operator may divulge the contents of an intercepted message if the message is for the use of the general public or relating to ships in distress.

Q. 17. If a licensee is notified that he has violated an FCC rule or provision of the Communications Act of 1934, what must he do? (R & R 1.76)

A. 17. Within 10 days from receipt of notice, or such other period as may be specified, the licensee shall send a written answer, in duplicate, direct to the office of the Commission originating the official notice. If an answer cannot be sent or acknowledgment made within such 10-day period by reason of illness or other unavoidable circumstances, acknowledgment and answer shall be made at the earliest practicable date with a satisfactory explanation of the delay. The answer to each notice shall be complete in itself and shall not be abbreviated by reference to other communications or answers to other notices. In every instance, the answer shall contain a statement of action taken to correct the condition or omission complained of and to preclude its recurrence. In addition: (1) If the notice relates to violations that may be due to the physical or electrical characteristics of transmitting apparatus and any new apparatus is to be installed, the answer shall state the date such apparatus was ordered, the name of the manufacturer, and the promised date of delivery.

Q. 18. If a licensee receives a notice of suspension of his license, what must he do? (R & R 1.72)

A. 18. If a licensee receives a notice of suspension of his license, he must make a written application to the Commission within 15 days of receipt of the notice for a hearing on the suspension order.

Q. 19. What are the penalties provided for violating a provision of the Communications Act of 1934 or a Rule of the FCC? (Sec. 501, 502)

A. 19. Any person who willfully and knowingly violates the Communications Act of 1934 shall, upon conviction thereof, be punished for such offense, for which no penalty (other than a forfeiture) **is provided in this Act, by a fine of not more than $10,000 or by imprisonment for a term not exceeding one year, or both; except that any person, having been once convicted of an offense punishable under this section, who is subsequently convicted of violating any provision of this Act punishable under this section, shall be punished by a fine of not more than $10,000 or by imprisonment for a term not exceeding two years; or both.**

Any person who willfully and knowingly violates any rule, regulation or restriction made by the Commission under authority of this Act, or any rule, regulation or restriction made by any international communications treaty to which the United States is or may hereafter become a party, shall, in addition to any other penalties provided by law, be punished, upon conviction thereof, by a fine of not more than $500 for each and every day during which such offense occurs.

Q. 20. Define "harmful interference". (ART.)

A. 20. Harmful interference is any emission, radiation or induction which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunication service.

ELEMENT 2 — SERIES "O"

Ques. 1. What should an operator do when he leaves a transmitter unattended?

Ans. 1. Precautions should be taken so that the equipment will not be subjected to use by unauthorized personnel.

Q. 2. What are the meanings of: clear, out, over, roger, words twice, repeat, and break?

A. 2(a). "Clear" indicates that the transmission is completed, and that no response is expected.

(b) "Out" is similar in meaning to "clear". It indicates that the conversation is ended and no response is expected.

(c) "Over" indicates that the transmission has ended and a response is expected.

(d) "Roger" indicates that the immediately preceding message has been received, and is completely understood.

(e) "Words twice" is used to indicate that a series of words will be sent two times due to poor reception conditions or general communications difficulty.

(f) "Repeat" means to say again.

(g) The term "break" is used as a separation between parts of a single message.

Q. 3. How should a microphone be treated when used in noisy locations?

A. 3. It is good practice for the operator to shield the microphone with his hands when speaking into a microphone in a noisy location. This tends to cut down the microphone's picking up of background noise.

Q. 4. What may happen to the received signal when an operator has shouted into a microphone?

A. 4. Shouting into the microphone generally causes overmodulation. This results in speech distortion, as well as interference with stations on adjacent frequencies.

Q. 5. Why should radio transmitters be "off" when signals are not being transmitted?

A. 5. The transmitter should be off to prevent causing interference to other stations on the frequency.

Q. 6. Why should an operator use well-known words and phrases?

A. 6. Simple phrases and plain language are easier to understand. This reduces the number of errors that are made, and minimizes the amount of repetition necessary.

Q. 7. Why is the station's call sign transmitted?

A. 7. A station's call sign is transmitted so as to enable one to identify the station and thus avoid possible confusion. A proper station identification consists of the call letters and location of the station.

Q. 8. Where does an operator find specifications for obstruction marking and lighting (where required) for the antenna towers of a particular radio station?

A. 8. If an operator wishes to determine the specifications for obstruction marking and lighting of antenna towers, he should look in Part 17 of the Rules and Regulations of the FCC. If he wishes to determine the specifications for a particular station, he should examine the station authorization issued by the Commission.

Q. 9. What should an operator do if he hears profanity being used at his station?

A. 9. The licensed operator on duty should endeavor to end the transmission and should enter the relevant details in the log of the station. A report of the incident should be submitted to the FCC.

Q. 10. What should an operator do if the station he is calling does not answer within a reasonable length of time?

A. 10. He should stop calling and wait a reasonable length of time before attempting to call again. Continuous calling without results only causes interference and takes up valuable airways space that could be used by others.

Q. 11. When may an operator use his station without regard to certain provisions of his station license? (R & R 2.405)

A. 11. The licensee of any station, except amateur, may, during a period of emergency in which normal communication facilities are disrupted as a result of hurricane, flood, earthquake or similar disaster, utilize such station for emergency communication service in communicating in a manner other than that specified in the instrument of authorization: Provided: (a) That as soon as possible after the beginning of such emergency use, notice be sent to the Commission at Washington, D. C., and to the Engineer in Charge of the district in which the station is located, stating the nature of the emergency and the use to which the station is being put, and (b) That the emergency use of the station shall be discontinued as soon as substantially normal communication facilities are again available, and (c) That the Commission at Washington, D. C., and the Engineer in Charge shall be notified immediately

when such special use of the station is terminated.

Q. 12. Who bears the responsibility if an operator permits an unlicensed person to speak over his station?

A. 12. When a licensed operator in charge of a radiotelephone station permits another person to use the microphone and talk over the facilities of the station, he should remember that he continues to bear the responsibility for the proper operation of the station.

Q. 13. What is meant by a "phonetic alphabet" in radiotelephone communications?

A. 13. A phonetic alphabet is one in which a specific word is used to represent a letter of the alphabet; each letter has its corresponding word. For instance, the letter "A" may be made more easily recognizable by means of the word "Able", the word "Baker" is used to signify the letter "B", and the letter "C" is distinguished by use of the word "Charlie". By using one of the established phonetic symbols, the transmitting station makes clear to the receiving station exactly what letter is meant. This cuts down greatly on the amount of confusion and error, since many letters of the alphabet are similar in sound and may easily be confused.

Q. 14. How does the licensed operator of a station normally exhibit his authority to operate the station?

A. 14. An operator normally exhibits his authority to operate a station by posting a valid operator license or permit at the transmitter control point.

Q. 15. What precautions should be observed in testing a station on the air?

A. 15. In testing a radiotelephone transmitter, the operator should clearly indicate that he is testing, and the station call sign or name of the station, as required by the rules, should be clearly given. Tests should be as brief as possible. Caution should be observed by persons testing a station to make certain their test message will not interfere with other communications in progress on the same channel. Testing is important since it tells the operator whether the equipment is functioning properly. One of the primary duties of the operator is to maintain the equipment in proper operating condition.

ELEMENT 9

In recent years, Radiotelephone Third Class Operators with Broadcast Endorsements, have been given expanded privileges and duties. Some of these duties are somewhat technical in nature. To keep pace with these expanded duties, the FCC requires the Third Class Operator, with a Broadcast Endorsement, to have more technical knowledge than was previously required. The scope of the Element 9 examination has therefore been expanded to include additional technical and semi-technical questions.

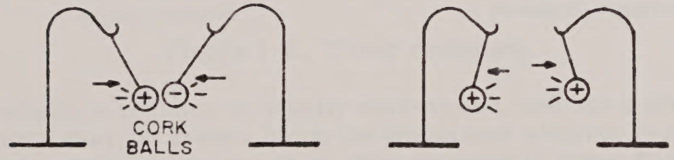
Previous editions of this book contained only the questions and answers given on Page 29. To meet the demand for the additional required knowledge, we are presenting the following basic information on radio theory. The prospective operator should be thoroughly familiar with the material contained in the questions and answers, as well as the basic radio theory.

The information in this book is sufficient for the prospective third class operator. However, if more technical information is desired, the AMECO "Commercial Radio Operator Theory Course" or "Radio Electronics Made Simple" publications can be consulted. These books are described on the back cover of this book.

BASIC RADIO THEORY

1-1 MATTER AND ELECTRICITY

Matter is a general term used to describe all the material things about us. Matter includes all man-made structures, woods, metals, gases, etc.; in other words, everything tangible. All matter, regardless of its size, quality or quantity, can be broken down fundamentally into two different types of particles. These particles, which are too small to be seen under a powerful microscope, are called ELECTRONS and PROTONS. Electrically, we say that the ELECTRON is NEGATIVELY charged and the PROTON is POSITIVELY charged. Also, the proton is about 1800 times as heavy as the electron.



A. Unlike charges attract. B. Like charges repel.

Figure 1-1. Attraction and repulsion.

1-2 THE LAW OF ELECTRIC CHARGES

Any object, such as a piece of glass, normally has a neutral or zero charge; that is, it contains as many electrons as protons. If this piece of glass can be made to have an excess of electrons, it is said to be negatively charged. Conversely, if the piece of glass can somehow be made to have a deficiency of electrons, the protons will predominate, and it is then said to be positively charged.

If a positively charged body is brought near a negatively charged body, the two objects will be drawn together. On the other hand, if two positively charged bodies or two negatively charged bodies are brought near each other, they will try to move away from each other. This reaction is the basis for our first law of electricity - the LAW OF ELECTRIC CHARGES. The law states "like charges repel, unlike charges attract". This law is illustrated by Figures 1-1A and 1-1B. In Figure 1-1A, a positively charged ball of cork is suspended by a piece of string near a negatively charged ball of cork. The two bodies swing toward each other since they attract each other. Figure 1-1B illustrates the two positively charged balls repelling each other.

1-3 DIFFERENCE OF POTENTIAL

If we were to connect a copper wire between the negative and the positive balls of cork, an electron flow would result. This is illustrated in Figure 1-2. The excess electrons from the negative ball would flow onto the positive ball where there is an electron deficiency and therefore, an attraction for the electrons. This flow continues until the deficiency and excess of electrons has disappeared and the balls become neutral or uncharged. This flow of electrons between the two differently charged bodies is caused by the difference in charge. A difference in charge between two objects will always result in the development of an electrical pressure between them. It is this electrical pressure that causes a current flow between these two bodies when they are connected by a piece of copper wire. This electrical pressure is defined as a DIFFERENCE OF POTENTIAL. The words "POTENTIAL" and "CHARGE" have similar meanings.

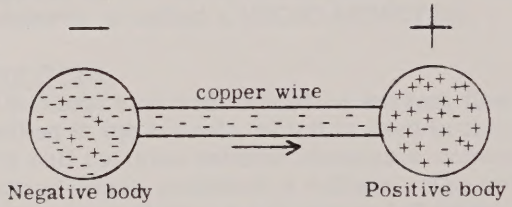


Figure 1-2. Flow of electrons.

1-4 CONDUCTORS AND INSULATORS

Materials through which current can easily flow are called CONDUCTORS. Most metals are good conductors. Conductors incorporate a large number of free electrons in their atomic structure. These free electrons are not held tightly and will move freely through the conductor when stimulated by external electrical pressure. Examples of good conductors, in the order of their conductivity, are silver, copper, aluminum and zinc.

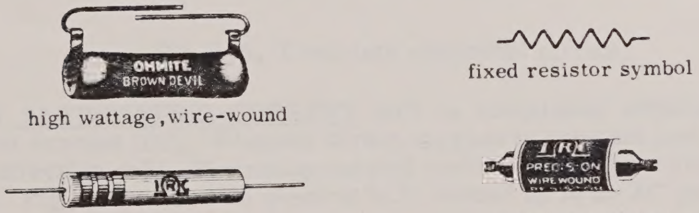
Those materials through which current flows with difficulty are called INSULATORS. The electrons are tightly held in the atomic structure of an insulator and, therefore, cannot move about as freely as in conductors. Examples of insulators are wood, silk, glass and bakelite.

1-5 RESISTANCE

The ability of a material to oppose the flow of current is called RESISTANCE. All materials exhibit a certain amount of resistance to current flow. In order to compare the resistances of various materials, we require some standard unit of resistance measurement. The unit of resistance that was adapted for this purpose was the OHM, and the Greek letter Ω is its symbol. 1 ohm is defined as the amount of resistance inherent in 1,000 feet of #10 copper wire. For example, 5,000 feet of #10 copper wire would have a resistance of 5 ohms, 10,000 feet of #10 copper wire would have 10 ohms, etc. Although the ohm is the basic unit, the MEGOHM, meaning 1,000,000 ohms, is frequently used. The instrument used to measure resistance is the OHMMETER.

1-6 RESISTORS

The resistor is a common radio part with a built-in specific amount of resistance. Resistors which are made of mixtures of carbon and clay are called carbon resistors. Carbon resistors are used in low power circuits. Wire wound resistors, which contain special resistance wire, are used in high power circuits. Figure 1-3 illustrates several types of fixed resistors which are used in radio circuits, together with the symbol which is used to represent them in circuit diagrams. When it becomes necessary to vary the amount of resistance in a circuit, we use adjustable and VARIABLE RESISTORS.



high wattage, wire-wound

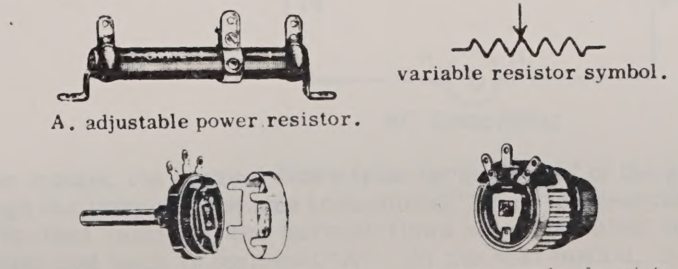
fixed resistor symbol

carbon resistor

precision resistor

Figure 1-3. Fixed resistors.

The adjustable resistor is usually wire-wound, and has a sliding collar which may be moved along the resistance element to select any desired resistance value. It is then clamped in place. Figure 1-4A shows an adjustable resistor.



A. adjustable power resistor.

variable resistor symbol.

B. volume control potentiometer.

C. power supply rheostat.

Figure 1-4. Variable resistors.

Variable resistors are used in a circuit when a resistance value must be changed frequently. Variable resistors are commonly called potentiometers or rheostats, depending upon their use. The resistance is varied by sliding a metal contact across the resistance in such a way so as to get different amounts of resistance. The volume control in a radio is a typical example of a variable resistor. Figure 1-4 B shows a potentiometer used as a volume control for a radio receiver; Figure 1-4 C shows a potentiometer wound of heavier wire for use in a power supply circuit.

1-7 VOLTAGE AND CURRENT

Voltage is another term for the difference of potential or electrical pressure which we spoke about in a preceding paragraph. It is the force which pushes or forces electrons through a wire, just as water pressure forces water through a pipe. Some other terms used to denote voltage are EMF (electro-motive force), IR DROP and FALL OF POTENTIAL. The unit of voltage is the VOLT and the instrument used to measure voltage is the VOLTMETER. The KILOVOLT is equal to 1000 volts.

Current is the flow of electrons through a wire as a result of the application of a difference of potential. If a larger amount of electrons flow past a given point in a specified amount of time, we have a greater current flow. The unit of current is the AMPERE; it is equal to 6,300,000,000,000,000,000 electrons flowing past a point in one second. MILLIAMPERE and MICROAMPERE are terms used to denote one-thousandth and one-millionth of an ampere, respectively. Current is measured by an AMMETER. A meter whose scale is in milliamperes is called a MILLIAMMETER, and a meter that reads microamperes is called a MICROAMMETER.

1-8 THE DRY CELL

Several methods are used to produce current flow or electricity. A common method is the dry cell, which is used in the ordinary flashlight. The dry cell contains several chemicals combined to cause a chemical reaction which produces a voltage. The voltage produced by all dry cells, regardless of size, is 1-1/2 volts. A battery is composed of a number of cells. Therefore, a battery may be 3 volts, 6 volts, 7-1/2 volts, etc., depending upon the number of cells it contains. The fact that a cell is larger than another one indicates that the larger cell is capable of delivering current for a longer period of time than the smaller one. Figure 1-5 illustrates a typical 1-1/2 volt cell and a 45 volt battery. The 45 volt battery contains 30 cells.

BURGESS
CHROME
PROTECTED
FRESH
POWER

Fig. 1-5A. 1-1/2 v. flashlight cell.

BURGESS
BATTERY

Fig. 1-5B. 45 v. "B" battery.

Every cell has a negative and a positive terminal. The electrons leave the cell at the negative terminal, flow through the circuit, and return to the cell at the positive terminal. This type of current flow is known as DIRECT CURRENT (DC). Direct current flows only in ONE direction.

1-9 ELECTRICAL CIRCUITS

Figure 1-6 is a diagram of a complete electrical circuit. The arrows indicate the direction of the current flow. As long as we can trace the current from the negative point of the cell, all around the circuit and back to the positive point, we have a complete circuit. The important thing to remember is that current will only flow through a complete circuit.

The necessary parts for a complete circuit are:

(1) A source of voltage - the dry cell in Figure 1-6.
(2) Connecting leads - the copper wire conductors in Figure 1-6.
(3) A load - the bulb in Figure 1-6.

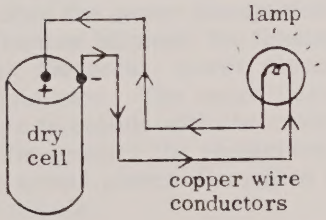
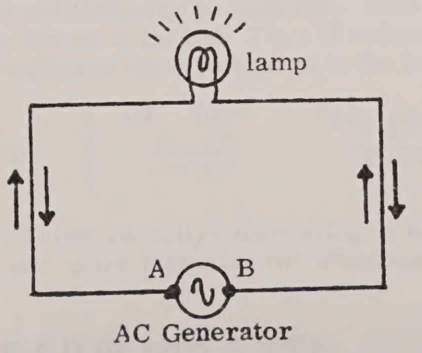


Fig. 1-6. Complete electrical circuit.

1-10 ALTERNATING CURRENT (AC) is completely different from direct current (DC). Whereas direct current is constant and flows in one direction only, alternating current continuously changes its direction. Fig. 1-7 shows an electric bulb hooked up to an AC generator.

Figure 1-7.



At one instant, the current flows from terminal "A" of the generator, through the lamp and returns to terminal "B" of the generator. During the next instance, the current flows out of terminal B, through the lamp and back to terminal "A". At the next instant, it reverses itself, etc. etc.

Not only does alternating current reverse itself, as described above, it also continuously varies in strength from zero to some peak value. When an AC voltmeter reads AC voltage, it obviously does not read the instantaneous fluctuations; it reads its effective value.

Alternating current can be generated mechanically by an AC generator. It can also be generated by electronic means-by various tube and transistor circuits. Both AC and DC are present in a transmitter. However, the signal at the antenna that is to be transmitted is AC.

FREQUENCY. The flow of alternating current, first in one direction, then in the opposite direction, is called a complete "cycle". The frequency of alternating current is the number of complete cycles that occur in one second. The unit of frequency is cycles per second that occur in one second. The abbreviation for cycles per second is CPS. In or simply cycles. The abbreviation for cycles per second is CPS. In recent years, the term "Hertz" (abbreviated "Hz"), has been used in place of cycles. The meter used to measure frequency is called a Frequency Meter.

The frequency of the AC power that is supplied to most homes in the United States is 60 Hertz. This is known as the POWER FREQUENCY. Radio waves transmitted by radio stations have a frequency much higher than the 60 Hz power frequency. Their frequency is generally above 20,000 Hz. An electrical frequency higher than 20,000 Hz is known as a RADIO FREQUENCY. The abbreviation for radio frequency is "RF".

Sound waves which can be heard by the human ear are called audible sounds or audio sounds. The frequency of the audio sounds lie in the range from 16 to 16,000 Hz. When a sound wave frequency is converted into an electrical frequency, it is known as an audio frequency (AF). For example, when our voice is amplified by a public address system, the sound waves from our throats strike the microphone and are converted into electrical frequencies, or audio frequencies.

When a frequency is given as a large number of Hz, it can be converted into smaller units of kiloHertz per second or MegaHertz per second, just as pennies can be converted into dollars. Example:

(a) 1,000 Hertz = 1 kiloHertz. The abbreviation for kiloHertz is "kHz". (The prefix kilo always means 1,000). Therefore, in order to convert Hertz into kiloHertz, we divide the number of Hertz by 1,000.

$$1,000,000 \text{ Hz} = \frac{1,000,000}{1,000} = 1,000 \text{ kHz}.$$

(b) 1,000,000 Hz = 1 MegaHertz. The abbreviation for MegaHertz is "MHz". Therefore, in order to convert Hertz into MegaHertz, we divide the number of Hertz by 1,000,000.

$$1,000,000 \text{ Hz} = \frac{1,000,000}{1,000,000} = 1 \text{ MHz}.$$

1-11 POWER

Whenever current flows through a resistance, there is friction

between the moving electrons and the molecules of the resistor. This friction causes heat to be generated, as does all friction. We could also say that electrical energy is changed to heat energy whenever current flows through a resistor. The unit of energy is the JOULE. The rate at which the heat energy is generated is the power that the resistor consumes. This power consumption in the form of heat represents a loss because we do not make use of the heat generated in radio circuits.

We should know how much heat power a resistor is consuming or dissipating. This is important because a resistor will burn up if it cannot stand the heat that is being generated by current flow. Resistors are, therefore, rated, not only in ohms, but in the amount of power that they can dissipate without overheating. The unit of electrical power is the WATT. A resistor rated at 5 watts is one which can safely dissipate up to 5 watts of power. If this resistor is forced to dissipate 10 watts, by increased current flow, it will burn up.

Exactly how much power is dissipated in a particular circuit, and upon what factors does the power dissipation depend? Since the power is the result of friction between the flowing electrons and the resistance in the circuit, the actual power dissipated depends upon the current and the resistance. The more current that flows, the more electrons there are to collide with the molecules of the resistance material. Also, the greater the resistance, the greater is the resulting friction. The actual power dissipated in a resistor can be found by the following formula:

$P = I^2 \times R$ — where: P is the power in watts

(I^2 means $I \times I$) — I is the current in amperes

R is the resistance in ohms

Problem: Find the power dissipated in a 2000 ohm resistor with 50 milliamperes flowing through it.

Solution: First change milliamperes to amperes. This is done by moving the decimal three places to the left. Thus 50 milliamperes equals .05 ampere. Then substitute the values given in the formula.

(1) $P = I^2 \times R$

(2) $P = .05 \times .05 \times 2000$

(3) $P = 5$ watts

$$\begin{array}{r} (1)\ .05 \\ \times\ .05 \\ \hline .0025 \end{array} \qquad \begin{array}{r} (2)\ .0025 \\ \times\ 2000 \\ \hline 5.0000 \end{array}$$

By using Ohm's law and algebraically substituting in the above formula, we can arrive at two more formulas for obtaining power dissipation.

$$P = E \times I \qquad P = \frac{E^2}{R}$$

where: P is the power in watts,

E is the voltage in volts,

I is the current in amperes and

R is the resistance in ohms.

The Wattmeter is the instrument that is used to measure power. The Watt-hour meter is the instrument that is used to measure energy.

INTRODUCTION TO TRANSMISSION AND RECEPTION

The diagram in Figure 8 represents a bird's eye view of a complete communications system. Instead of drawing out the individual circuits, a series of boxes are drawn. Each box represents a stage. (A stage is a tube or transistor with its associated parts.) The function of each stage is printed inside the box. Such a diagram is known as a block diagram.

Fig. 8-A illustrates a block diagram of a radio-telephone transmitter. Let us see briefly what the function is of each stage outlined in the block diagram. The heart of the transmitter is the oscillator. Its sole purpose is to generate a high frequency alternating current. This high frequency AC is called radio frequency or RF. The output of the oscillator is fed to the radio frequency amplifier which simply amplifies the RF output from the oscillator. The output of the RF amplifier is then fed to the RF power amplifier. The RF power amplifier amplifies the RF in terms of power. The power amplifier then supplies the antenna with the RF power that is to be radiated into space. Up to this point, we have only discussed the generation and transmission of a radio frequency wave which, by itself, contains no intelligence. The intelligence that we desire to transmit is the audio in the form of voice or music. Let us see how the audio is radiated into space.

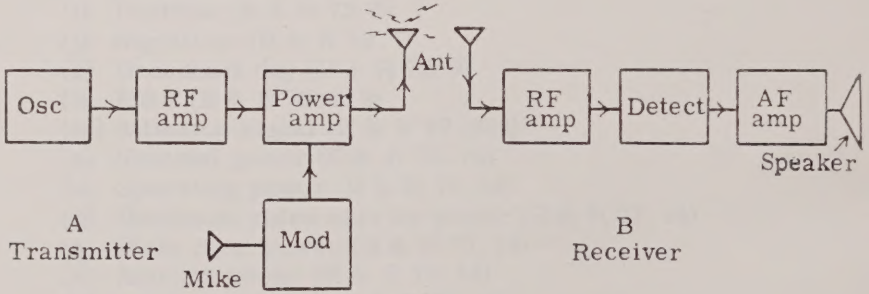


Figure 8. Radio transmitter and receiver.

The function of the microphone is to convert sound energy into electrical energy. The output of the microphone is applied to the modulator, which is simply an audio amplifier. The modulator serves two functions: (1) it amplifies the weak audio output of the microphone and (2) it superimposes the audio onto the radio frequency energy that is present at the power amplifier stage, by a process called modulation. The audio is combined with the RF wave because an audio wave by itself is not capable of traveling through space. High frequency such as RF, however, is capable of traveling through space. Therefore, the RF acts as the "carrier" for the audio; the RF carries the audio from the transmitter to the receiver. The combined audio RF output of the power amplifier is fed to the antenna where it is radiated out into space in the form of electromagnetic waves.

At the receiving end of the communications system, the electro-

magnetic waves induce small voltages into the receiving antenna. These signal voltages are quite weak because the electromagnetic waves have travelled some distance before striking the receiving antenna. Therefore, the signal voltages must be amplified; this is the function of the first stage in the receiver called the RF amplifier. The output of this stage is applied to the detector. Just as the oscillator is the heart of the transmitter, the detector is the heart of the receiver. The detector stage separates the audio from the RF carrier. The carrier has served its purpose in bringing the audio to the receiver. Now, all we are interested in is the audio. The audio output of the detector is then fed to an audio amplifier stage to be amplified. The amplified audio is applied to a speaker which converts the audio electrical variations back into the original sound that energized the microphone of the transmitter.

ELEMENT 9*

Question 1. What is meant by the following words or phrases?

(a) Standard broadcast station (AM) (R & R 73. 1)
(b) Standard broadcast band (R & R 73. 2)
(c) Standard broadcast channel (R & R 73. 3)
(d) FM station (R & R 73. 310)
(e) FM band (R & R 73. 310)
(f) FM Stereophonic Broadcast (R & R 73. 310)
(g) FM Subsidiary Communications Authorization (SCA) (R & R 73. 293)
(h) Sunrise and Sunset (R & R 73. 8)
(i) Daytime (R & R 73. 6)
(j) Nighttime (R & R 73. 7)
(k) Broadcast day (R & R 73. 9)
(l) EBS (R & R 73. 912)
(m) Attention signal (R & R 73. 906)
(n) Nominal power (R & R 73. 14)
(o) Operating power (R & R 73. 14)
(p) Maximum rated carrier power (R & R 73. 14)
(q) Plate input power (R & R 73. 14)
(r) Antenna power (R & R 73. 14)
(s) Antenna current (R & R 73. 14)
(t) Antenna resistance (R & R 73. 14)
(u) Percentage modulation (amplitude) (R & R 73. 14)

Answer 1(a). The term "standard broadcast station" (AM) means a broadcasting station licensed for the transmission of amplitude-modulated (voice type) emissions primarily intended to be received by the general public and operated on a channel in the band - 535 kiloHertz to 1605 kiloHertz.

(b) The term "standard broadcast band" means the band of frequencies between 535 kiloHertz and 1605 kiloHertz.

(c) The term "standard broadcast channel" means the band of frequencies occupied by the carrier and two side bands of a broadcast signal with the carrier frequency at the center. Channels shall be designated by their assigned carrier frequencies. The 107 carrier frequencies assigned to standard broadcast stations shall begin at 540 kiloHertz and be in successive steps of 10 kiloHertz.

(d) The term "FM station" means a station employing frequency modulation in the FM broadcast band and licensed primarily for the transmission of radiotelephone emissions intended to be received by the general public.

(e) The term "FM band" means the band of frequencies extending from 88 to 108 megaHertz, which includes those assigned to noncommercial educational broadcasting.

(f) The term "FM Stereophonic Broadcast" means the transmission of a stereophonic program by a single FM broadcast sta-

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* See note in Preface concerning Element 9 examination.

tion utilizing the main channel and a stereophonic subchannel.

(g) An "FM Subsidiary Communications Authorization" (SCA) is an authorization granted to an FM station for the simultaneous transmission of one or more signals on assigned subcarrier frequencies within the station's assigned channel. Special decoding equipment is required to receive program material furnished on the SCA subchannel. Such material, although broadcast related, is normally intended for paying subscribers.

(h) The terms "sunrise" and "sunset" mean, for each particular location and during any particular month, the time of sunrise and sunset as specified in the instrument of authorization. Specifying the times of sunrise and sunset on the station license is important because not all standard (AM) broadcast stations are permitted to operate at night. In order to control objectionable skywave interference, stations which are permitted to operate at night are frequently required to change their modes of operation. These changes may involve the use of directional antenna systems, a reduction in operating power, or both, and normally occur at the sunrise and sunset times, listed in the station license.

(i) The term "daytime" means the period of time between the local sunrise and the local sunset.

(j) The term "nighttime" means that period of time between local sunset and local sunrise.

(k) The term "broadcast day" means the period of time between local sunrise and 12 midnight, local standard time.

(l) "EBS" stands for Emergency Broadcast System. The Emergency Broadcast System consists of the facilities and personnel of nongovernment broadcast stations and interconnecting facilities which have been authorized by the Federal Communications Commission to operate in a controlled manner during a war, threat of war, state of public peril or disaster, or other national emergency.

(m) The "attention signal" is the signaling arrangement whereby standard, FM and television broadcast stations can actuate mute receivers for interstation receipt of emergency cueing announcements and broadcasts. It consists of two audio tones having fundamental frequencies of 853 and 960 Hertz and shall not vary over ±0.5 Hertz. The two tones, with specified frequency tolerances and harmonic distortion limits, modulate the transmitter simultaneously at no less than 40% for an automatic time period of not less than 20 seconds, nor longer than 25 seconds.

The total harmonic distortion of each of the audio tones shall not exceed 5%.

(n) "Nominal power" is the power of a standard broadcast station, as specified in a system of classification which includes the following values: 50 kW., 25 kW., 10 kW., 5 kW., 1 kW., 0.5 kW., 0.25 kW.

(o) Depending on the context within which it is employed, the term "operating power" may be synonymous with "nominal power" or "antenna power". The operating power for AM stations is normally the antenna input power and for FM stations, it is the transmitter output power.

(p) "Maximum rated carrier power" is the maximum power at which the transmitter can be operated satisfactorily, and is determined by the design of the transmitter and the type and number of vacuum tubes used in the last radio stage.

(q) "Plate input power" means the product of the direct plate voltage applied to the tubes in the last radio stage, and the total direct current flowing to the plates of these tubes, measured without modulation.

(r) "Antenna input power" or "antenna power" means the product of the square of the antenna current and the antenna resistance at the point where the current is measured.

(s) "Antenna current" means the radio-frequency current in the antenna with NO MODULATION.

(t) "Antenna resistance" means the total resistance of the transmitting antenna system at the operating frequency and at the point at which the antenna current is measured.

(u) "Percentage modulation" with respect to an amplitude modulated wave means the ratio of half the difference between the maximum and minimum amplitudes of the amplitude modulated wave to the average amplitude expressed in percentage.

Q. 2. Make the following transformations:
(a) Kilocycles to cycles. (c) Milliamperes to amperes.
(b) Kilovolts to volts. (d) Watts to kilowatts.

A. 2(a) One kilocycle (kc) is equal to 1,000 cycles (c). Therefore, in order to change kilocycles to cycles, we multiply by one thousand. In order to change cycles to kilocycles, we divide by one thousand. Examples: 3 kilocycles equals 3,000 cycles. 1.4 kilocycles equals 1,400 cycles. 500 cycles equals .5 kilocycle.

In recent years, the electronics industry has adopted the term "Hertz", abbreviated "Hz", to replace the term "cycles". Kilocycles has been replaced by "kiloHertz", abbreviated "kHz"; megacycles (meaning one million cycles), has been replaced by "MegaHertz", abbreviated "MHz".

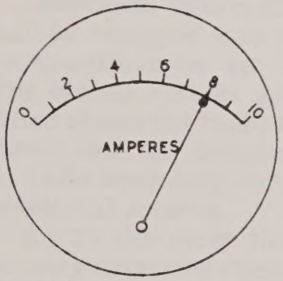
(b) One kilovolt is equal to 1,000 volts. Therefore, in order to change kilovolts (kv) to volts (v), we multiply by one thousand. In order to change volts to kilovolts, we divide by one thousand. Examples: 2.6 kilovolts equals 2,600 volts. 1 kilovolt equals 1,000 volts. 50 volts equals .050 kilovolt.

(c) One ampere is equal to 1,000 milliamperes. Therefore, in order to change milliamperes (ma.) to amperes (A), we divide by one thousand. In order to change amperes to milliamperes, we multiply by one thousand. Examples: 50 milliamperes equals .050 ampere. 200 milliamperes equals .2 ampere. .003 ampere equals

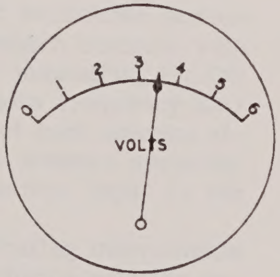
3 milliamperes.

(d) One kilowatt is equal to 1,000 watts. Therefore, in order to change watts to kilowatts, we divide by 1,000. In order to change kilowatts to watts, we multiply by 1,000. Examples: 3.4 kilowatts equals 3,400 watts. 250 watts equals .25 kilowatts.

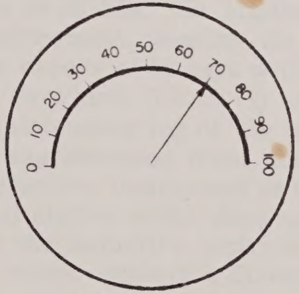
Q. 3. Draw the "face" of the following meters and know how to read each: (a) Ammeter. (b) Voltmeter. (c) Arbitrary scale meter. (d) Frequency monitor meter. (e) VU meter (for % modulation). (f) Milliammeter. (g) Antenna phase meter. (h) RF transmission line power meter.


0
2
4
6
8
10
AMPERES

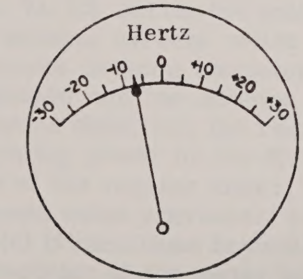
(a) Ammeter.
Reading shown
is 8 amperes.


0
1
2
3
4
5
6
VOLTS

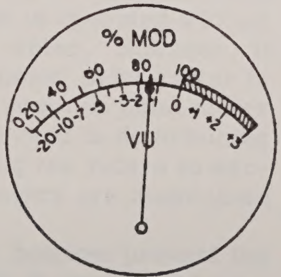
(b) Voltmeter.
Reading shown
is 3.5 volts.


0
10
20
30
40
50
60
70
80
90
100

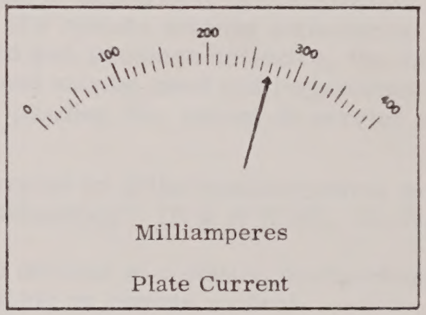
(c) Arbitrary
scale meter.


Hertz
-30
-20
-10
0
+10
+20
+30

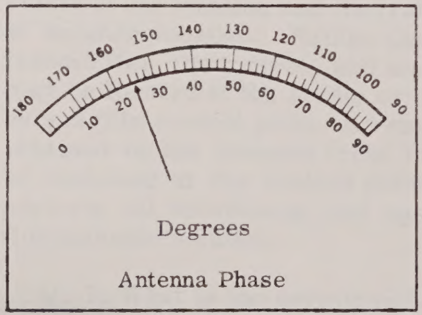
(d) Frequency Monitor
Meter indicates deviation in
Hertz. (kHz for FM stations)
Reading shown is -7 Hertz.


% MOD
0
20
40
60
80
100
-20
-10
-7
-5
-3
-2
-1
0
+1
+2
+3
VU

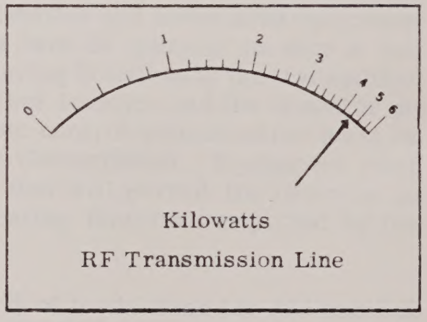
(e) VU Meter.
For % modulation, scale is
made larger than VU scale.
Reading shown is 85% mod.


0
100
200
300
400
Milliamperes
Plate Current

(f) Milliammeter.
Reading is 270 ma.


180
170
160
150
140
130
120
110
100
90
0
10
20
30
40
50
60
70
80
90
Degrees
Antenna Phase

(g) Antenna Phase Meter.
Reading on bottom scale
is 25 degrees.


0
1
2
3
4
5
6
Kilowatts
RF Transmission Line

(h) Transmission Line Wattmeter.
Reading is 4.5 kilowatts.

Q. 4. What indicating instruments are found in a broadcast transmitter? What should an operator know about these instruments? (R & R 73.39, 73.58, 73.258, 73.558)

A. Each transmitter is equipped with meters to indicate plate voltage and plate current. These meters indicate the operating constants of the transmitter amplifier. Each transmitter has normal operating levels of plate voltage and plate current and the operator should know what corrective actions should be taken when the meters indicate abnormal values.

At the place in the circuit where the antenna resistance or common point resistance is measured, an antenna ammeter is inserted to measure current into the antenna system. This meter is a direct indication as to whether the station is operating at, above, or below the licensed power. This meter indication should be maintained as close as possible to the licensed operating current and the operator should know what actions are necessary when the meter indications deviate from that value. Usually the antenna ammeter is located at the base of the tower and not easily accessible to the operator on duty. For this reason, most stations use a remote antenna ammeter which is located at the normal operating position of the person on duty. The remote antenna ammeter in-

dication may be entered in the operating log, in lieu of the base current meter indication, provided the remote meter is calibrated once weekly.

All antenna current meters should be read when the transmitter is not being modulated. A break in programs is a good time to read the antenna current meters.

Q. 5. What should an operator do if the remote antenna ammeter becomes defective? (R & R 73.58)

A. If the remote antenna ammeter becomes defective, the antenna base currents may be read and logged once daily for each mode of operation, pending the return to service of the regular remote meter.

Additional information: (a) Each standard broadcast station shall be equipped with indicating instruments (which conform with the specifications set forth in Sec. 73.39) for measuring the DC plate circuit current and voltage of the last radio frequency amplified stage; the radio frequency base current of each antenna element; and, for stations employing directional antenna systems, the radio frequency current at the point of common input to the directional antenna.

(b) In the event that any one of these indicating instruments becomes defective when no substitute which conforms with the required specifications is available, the station may be operated without the defective instrument, pending its repair or replacement, for a period not in excess of 60 days without further authority of the Commission: Provided, That: (1) Appropriate entries shall be made in the maintenance log of the station, showing the date and time the meter was removed from and actually restored to service. (3) If the defective instrument is the antenna current meter of a nondirectional station which does not employ a remote antenna ammeter, or if the defective instrument is the common point meter of a station which employs a directional antenna, and does not employ a remote common point meter, the operating power shall be determined by the indirect method (in accordance with Sec. 73.52) during the entire time the station is operated without the antenna current meter or common point meter. However, if a remote antenna ammeter or a remote common point meter is employed and the antenna current meter or common point meter becomes defective, the remote meter may be used in determining operating power by the direct method, pending the return to service of the regular meter, provided other meters are maintained at same value previously employed.

(c) If conditions beyond the control of the licensee prevent the restoration of the meter to service within the above allowed period, informal request (in accordance with Sec. 1.549) may be filed with the Engineer-in-Charge of the radio district in which the station is located, for such additional time as may be required to complete repairs of the defective instrument.

(d) Remote antenna ammeters and remote common point meters are not required; therefore, authority to operate without them is not necessary. However, if a remote antenna ammeter or common point meter is employed and becomes defective, the antenna base currents (as stated above) may be read and logged once daily for each mode of operation, pending the return to service of the regular remote meter.

Q. 6. What should an operator do if the remote control devices at a station so equipped malfunction? (R & R 73.67, 73.274 and 73.575)

A. If the remote control devices at a station malfunction, the operator should cease operating by remote control.

Additional Information: Some broadcast stations have the main studio at one location and the transmitter and associated equipment at another location. Rather than have an operator on duty at the transmitter, the controls and metering functions of the transmitter may be located at the studio or other location and the operator on duty at this control point. A remote control authorization must be obtained by the licensee from the Commission. Equipment must be installed at the control point that will permit the operator to perform all monitoring and operating functions required by the Commission's rules.

Q. 7. What is the permissible % of modulation for AM and FM stations? (R & R 73.55, 73.268, 73.568)

A. Modulation in excess of 100% is called overmodulation. It is to be avoided because it causes interference in AM and FM transmission. It also causes distortion in AM transmission.

A low percentage of modulation is called undermodulation. Undermodulation is undesirable because it results in weak reception.

In both AM and FM, the percentage of modulation shall be maintained as high as possible, consistent with good quality of transmission and good broadcast practice.

In a standard (AM) broadcast station, the percentage of modulation is not to exceed 100% on negative peaks of frequent recurrence, or 125% on positive peaks at any time.

In FM, the percentage of modulation is not to exceed 100% on either positive or negative peaks of frequent recurrence.

In both AM and FM, the percentage of modulation should not be less than 85% on peaks of frequent occurrence; but where necessary to avoid objectionable loudness, modulation may be reduced to whatever level is necessary, even if the resulting modulation is substantially less than 85% on peaks of frequent occurrence.

Q. 8. What is the station requirement with respect to station monitors? (R& R 73.50, 73.56, 73.253, 73.268, 73.553, 73.568)

A. Each station must have in operation a modulation monitor which the operator uses to determine whether the modulation is at

the proper level. The modulation monitor consists of a meter and a peak flasher. The meter does not indicate the peak modulation, but indicates a value somewhat less than the peak modulation. The "peak flasher" indicates modulation peaks. Generally, the peak flasher is set so that when it flashes, it is an indication that the modulation is excessive and that corrective action must be taken by the operator.

Q. 9. What is the permissible frequency tolerance of standard broadcast stations? (R& R 73.59) Of FM stations? (R& R 73.269)

A. The operating frequency of each AM broadcast station should be maintained within 20 Hertz of the assigned frequency. The center frequency of each FM broadcast station should be maintained within 2,000 Hertz of the assigned center frequency.

Q. 10(a) How is the operating power of a standard broadcast station determined? (R& R 73.51) (b) What is the operating power of a normally operating standard (AM) broadcast station having a final plate voltage of 800 volts, a final plate current of 1000 ma., an antenna resistance of 52 ohms, an antenna current of 3.2 amperes and an F factor of 0.7. (c) How is the operating power of an FM station determined? (R & R 73.267) (d) Using the indirect method, what is the operating power of the above transmitter?

A. (a) (1) Except as provided in paragraph (2) of this section, the operating power shall be determined by the direct method (the square of the antenna current times the antenna resistance at the point where the current is measured and at the operating frequency). For example, if the antenna current is 4.2 amperes and the antenna resistance is 48 ohms, the operating power is:

$$4.2^2 \text{ x } 48 = 4.2 \text{ x } 4.2 \text{ x } 48 = 846.7 \text{ watts}$$

Non-directional AM broadcast stations employ only a single antenna tower. Power determined by the direct method is equal to the product of the antenna resistance and the square of the antenna current. Directional AM broadcast stations employ multiple radiating elements. Power determined by the direct method for these stations is equal to the product of the resistance common to all antenna towers (common point resistance) and the square of the current common to all antenna towers (common point current). At FM broadcast stations, if power is determined by the direct method, it is read directly from the RF transmission line meter. This meter must be calibrated each six months to give a direct indication of the power supplied to the antenna.

(2) Operating power shall be determined on a temporary basis by the indirect method: (i) In the case of an emergency where the licensed antenna system has been damaged by causes beyond the control of the licensee (see Sec. 73.45), or (ii) Pending completion of authorized changes in the antenna system, or (iii) If any change is made in the antenna system or any other change is made which may affect the antenna system. (See Sec. 73.45).

In the indirect method, the operating power or antenna power is found by the formula:

$$P = E_p \text{ x } I_p \text{ x } F.$$

where: E_p = plate voltage of last stage in volts, I_p = total plate current of last stage in amperes and F = efficiency factor. The efficiency factor is either given by the transmitter manufacturer or by a table in the Rules and Regulations (73.51).

For example, the operating power of a transmitter (using the indirect method), having a plate voltage of 2.8 kv, a plate current of 850 ma. and an "F" factor of .65, is:

$$2800 \text{ V x } .85 \text{ A x } .65 = 1547 \text{ watts or } 1.547 \text{ kw.}$$

Note that the voltage must be in volts and the current must be in amperes in order to use the formula properly.

(b) Since the direct method must be used, we used the power formula involving the antenna current (I) and the antenna resistance (R):

$$P = I^2R = (3.2)^2 \text{ x } 52 = 3.2 \text{ x } 3.2 \text{ x } 52 = 532.5 \text{ watts.}$$

(c) The operating power of an FM station is determined by using either the direct or the indirect method. Using the direct method, the power is measured by an RF transmission line meter at the output terminals of the transmitter, while operating into a dummy load of substantially zero reactance and a resistance equal to the transmission line characteristic impedance. The indirect method used for FM stations is the same as that used for AM stations.

(d) Using the indirect method formula, we can find the operating power:

$$P = E_p \text{ x } I_p \text{ x } F = 800 \text{ x } 1 \text{ x } .7 = 560 \text{ watts.}$$

Q. 11(a) What stations may be operated by a third class broadcast operator and what equipment adjustments may they perform? (b) What should be the normal operating position of a radio operator? (R & R 73.93, 73.265, 73.565)

A. Except for a very limited number of standard broadcast stations, using critical directional antenna arrays, licensees of AM and FM broadcast stations may employ third class operators for the routine station operations. However, if a station licensee elects to use third class operators, he is subject to many additional requirements. In most cases, a supervisory operator holding a Radiotelephone First-Class Operator's license must be employed either on a full-time or part-time basis.

The third class operator privileges do not include operation of television stations.

With the exceptions set forth below, adjustments of the transmitting system, inspection, maintenance, repairs, required equipment performance measurements and required field strength measurements must be performed only by a first-class radiotelephone

operator.

Except at times when the operation of the station is under the immediate supervision of an operator holding a valid radiotelephone first-class operator license, adjustments of the transmitting equipment by a third class operator shall be limited to the following:

(1) Those necessary to turn the transmitter on and off.

(2) Adjustments of external controls as may be required to compensate for voltage fluctuations in the power supply.

(3) Adjustments of external controls to maintain modulation of the transmitter within the prescribed limits.

(4) Adjustments of external controls necessary to effect routine changes in operating power which are required by the station's instrument of authorization.

(5) Adjustments of external controls necessary to effect operation in accordance with a National Defense Emergency Authorization during an Emergency Action Condition.

(6) Those necessary to change between nondirectional and directional or between differing radiation patterns, provided that such changes require only activation of switches and do not involve the manual tuning of the transmitter final amplifier or antenna phasor equipment. The switching equipment shall be so arranged that the failure of any relay in the directional antenna system to activate properly will cause the emissions of the station to terminate.

It shall be the responsibility of the licensee to insure that the person who may be required to perform these tasks, as well as to perform other duties (such as reading meters and making log entries) is properly instructed so as to be capable of performing the duties required of him at times when not under the immediate supervision of a radiotelephone first-class operator. Where necessary, printed step-by-step instructions shall be posted for those transmitter adjustments which the lesser grade operator is authorized to make. Should the transmitting apparatus be observed to be operating in any manner inconsistent with this subpart or the current instrument of authorization for the station at any time when an operator holding a valid radiotelephone first-class operator license is not immediately available, and none of the above adjustments is effective in correcting the condition of improper operation, the emissions of the station shall be immediately terminated.

(b) One or more operators holding a radio operator license or permit of a grade specified in this section, shall be in actual charge of the transmitting system, and shall be on duty either at the transmitter location or at the remote control point. If operation by remote control has not been authorized, the transmitter, required monitors and other required metering equipment, shall be readily accessible and located sufficiently close to the operator at the normal operating position that deviations from normal indications of required instruments can be observed within a 360° arc from that position. If operation by remote control is authorized, the required controls and instruments shall be readily accessible, and located sufficiently close to the operator at the normal operating position that deviations from normal indications of required metering instruments can be observed in a 360° arc from that position.

Q. 12. What are the power limitations on broadcast stations? (R & R 73.52)

A. The actual antenna input power of each station shall be maintained as near as is practicable to the authorized antenna input power and shall not be less than 90 percent nor greater than 105 percent of the authorized power; except that, if, in an emergency, it becomes technically impossible to operate with the authorized power, the station may be operated with reduced power for a period of 10 days, or less, without further authority from the Commission. If causes beyond the control of the permittee or licensee prevent restoration of authorized power within the allowed period, informal written request shall be made to the Commission in Washington, D. C., no later than the 10th day for such additional time as may be deemed necessary.

Noncommercial educational FM broadcast stations licensed to operate with transmitter output power of 10 watts or less, may be operated at less than the authorized power, but not more than 105 percent of the authorized power.

Q. 13. What logs must be kept by broadcast stations according to the Rules and Regulations of the FCC? (R & R 73.111)

A. The licensee or permittee of each standard broadcast station shall maintain program, operating and maintenance logs. The logs shall be kept in an orderly and legible manner, in suitable form, and in such detail that the data required for the particular class of station concerned is readily available. Time entries shall be either in local standard or daylight saving time and shall be indicated accordingly. Each log sheet shall be numbered and dated. No log or preprinted log or schedule which becomes a log, or portion thereof, shall be erased, obliterated, or willfully destroyed within the period of retention provided by the provision of this part. Any necessary correction shall be made only pursuant to Sections 73.112 and 73.113, and only by striking out the erroneous portion, or by making a corrective explanation on the log or attachment to it, as provided in those sections. Entries shall be made in the logs as required by Sections 73.112 and 73.113.

The operating log and the maintenance log may be kept individually on the same sheet in one common log, at the option of the permittee or licensee.

Q. 14. Who keeps the logs? (R & R 73.111)

A. Each log shall be kept by the station employee or employees (or contract operator) competent to do so, having actual knowledge of the facts required, who in the case of program and operating logs, shall sign the appropriate log when starting duty, and again when going off duty.

Q. 15. What entries are made in the program log? (R & R 73.112) In the operating log? (R & R 73.113)

A. The following entries shall be made in the program log:

(1) For each program: an entry identifying the program by name or title, an entry of the time each program begins and ends, an entry classifying each program as to type (news, religious, entertainment, sports), an entry classifying each program as to source, an entry for each program presenting a political candidate showing the name and political affiliation for such candidate.

(2) For commercial matter: an entry identifying the sponsor(s) of the program, the person(s) who paid for the announcement, or the person(s) who furnished materials or services of any kind (such as records, transcriptions, talent, scripts, etc.), an entry showing the total duration of commercial matter in each hourly time segment (beginning on the hour) or the duration of each commercial message (commercial continuity in sponsored programs, or commercial announcements) in each hour, and an entry showing that the appropriate announcements (sponsorship, furnishing material, or services, etc.) have been made. A check-mark (✓) will suffice but shall be made in such a way as to indicate the matter to which it relates.

(3) For Public service announcements: an entry showing that a public service announcement has been broadcast, together with the name of the organization or interest on whose behalf it has been made.

(4) For other announcements: an entry of the time that each station identification is made (call letters and licensed location), an entry for each announcement presenting a political candidate showing the name and political affiliation of such candidate, an entry showing that a mechanical reproduction announcement has been made. The licensee, whether employing manual or automatic logging, or a combination thereof, must be accurately able to furnish the Commission with all information required to be logged.

Manually kept log. Where, in any program log, or preprinted program log, or program schedule which upon completion is used as a program log, a correction is made before the person keeping the log has signed the log upon going off duty, such correction, no matter by whom made, shall be initialed by the person keeping the log prior to his signing of the log when going off duty, as attesting to the fact that the log, as corrected, is an accurate representation of what was broadcast. If corrections or additions are made on the log after it has been so signed, explanation must be made on the log or on an attachment to it, dated and signed by either the person who kept the log, the station program director or manager, or an officer of the licensee.

An FM station, operating under a Subsidiary Communications Authorization (SCA), should include in the log, at least once a day, a general description of the program content. Any changes in the program content and times of changes, should also be logged.

The following entries shall be made in the operating log by the properly licensed operator in actual charge of the transmitting apparatus, or by automatic devices. (See (b) below.)

(1) An entry of the time the station begins to supply power to the antenna and the time it stops. (2) See Answer 26.

(3) An entry at the beginning of operation in each mode and at intervals not exceeding three hours, of the following (actual readings observed prior to making any adjustments to the equipment) and, when appropriate, an indication of corrections made to restore parameters to normal operating values: (i) Operating constants of last radio stage (total plate voltage and plate current). (ii) Antenna current or common point current (if directional) without modulation.

(4) An entry each day of the following where applicable: (i) Antenna base current(s) without modulation for each mode of operation: (a) Where remote antenna meters or a remote common point meter are normally employed but are defective. (b) Where required by the station license for directional antenna operation. (ii) Where there is remote control operation of a directional antenna station, readings for each pattern taken at the transmitter (within two hours of commencement or operation with each pattern) of: (a) Common point current without modulation. (b) Base current(s) without modulation. (c) Phase monitor sample loop current(s) without modulation. (d) Phase indications.

(5) Any other entries required by the instrument of authorization or the provisions of this part.

(6) The entries required by Section 17.49 and (c) of this chapter. (b) Automatic devices accurately calibrated and with appropriate time, date and circuit functions may be utilized to record the entries in the operating log: Provided, That: (1) They do not affect the operation of circuits or accuracy of indicating instruments of the equipment being recorded; (2) The recording devices have an accuracy equivalent to the accuracy of the indicating instruments; (3) The calibration is checked against the original indicators at least once a week and the results noted in the maintenance log; (4) Provision is made to actuate automatically an aural alarm circuit located near the operator on duty, if any of the automatic log readings are not within the tolerances or other requirements specified in the rules or instrument of authorization; (5) Devices which record each parameter in sequence must read each parameter at least once during each 10-minute period and clearly indicate the parameter being recorded; (6) The automatic logging equipment is located at the remote control point if the transmitter

is remotely controlled, or at the transmitter location if the transmitter is manually controlled; (7) The automatic logging equipment is located in the near vicinity of the operator on duty and is inspected by him periodically during the broadcast day; and (8) The indicating equipment conforms with the requirements of Sec. 73.39 except that the scales need not exceed 2 inches in length and arbitrary scales may not be used.

Manually kept log. Any necessary corrections in a manually kept operating log shall be made only by the person making the original entry who shall make and initial each correction prior to signing the log when going off duty, in accordance with 73.111(a). If corrections or additions are made on the log after it has been so signed, explanation must be made on the log or on an attachment to it, dated and signed by either the operator who kept the log, the station technical supervisor or an officer of the licensee.

FM stations, using the direct method of determining power, log the RF transmission line meter reading rather than the antenna current, as in AM stations.

An FM station operating under a Subsidiary Communications Authorization must keep a log of its operation. The log may be included as part of the operating log for the main channel or may be kept separately. Entries are required of the time the subcarrier generator is turned on and when it is turned off (excluding subcarrier interruptions of 5 minutes or less). An entry is also required for the time modulation is applied to the subcarrier and the time the modulation is removed from the subcarrier.

FM broadcast stations with an operating power of 10 watts or less are only required to log the time the station begins to supply power to the antenna, the time it stops, and entries concerning the daily observations of tower lights.

Q. 16. When may abbreviations be used in the station's logs? (R & R 73.111)

A. Key letters or abbreviations may be used if proper meaning or explanation is contained elsewhere in the log.

Q. 17. How may a station's logs be corrected?(R & R 73.111).

A. Any necessary correction to a station's logs may be made by striking out the erroneous portion, initialing the correction made, and indicating the date of correction. Also, see Answer 15 above.

Q. 18. According to the Rules and Regulations of the FCC, how long must station logs be retained? (R & R 73.115)

A. Logs of standard broadcast stations shall be retained by the licensee or permittee for a period of two years: Provided, however, That logs involving communications incident to a disaster or which include communications incident to or involved in an investigation by the Commission and concerning which the licensee or permittee has been notified, shall be retained by the licensee or permittee until he is specifically authorized in writing by the Commission to destroy them: Provided, further, That logs incident to or involved in any claim or complaint of which the licensee or permittee has notice, shall be retained by the licensee or permittee until such claim or complaint has been fully satisfied, or until the same has been barred by statute limiting the time for the filing of suits upon such claims.

Q. 19. What information must be given to an FCC inspector at any reasonable hour? (R & R 73.116)

A. The following shall be made available upon request by an authorized representative of the FCC: (a) Program, operating and maintenance logs. (b) Equipment performance measurements required by Sec. 73.47. (c) Copy of most recent antenna resistance or common-point impedance measurements submitted to the Commission. (d) Copy of most recent field intensity measurements to establish performance of directional antennas required by Sec. 73.151.

The above information must be made available for inspection by representatives of the FCC at any reasonable hour.

Q. 20. What must be included in a station identification and how often is it given? (R & R 73.1201)

A. Station identification shall consist of the station's call letters, immediately followed by the name of the community or communities, specified in its license as the station's location.

These identification announcements must be made: (1) At the beginning (sign-on) and ending (sign-off) of each time of operation, and (2) hourly, as close to the hour as feasible, at a natural break in program offerings. Television broadcast stations may make these announcements visually or aurally. The only legal requirement for "sign-on" or "sign-off" is the correct station identification.

Q. 21. What should an operator do if the modulation monitor becomes defective? (R & R 73.56)

A. (a) Each station shall have in operation, either at the transmitter or at the place the transmitter is controlled, a modulation monitor of a type approved by the Commission. (b) In the event that the modulation monitor becomes defective, the station may be operated without the monitor, pending its repair or replacement, for a period not in excess of 60 days without further authority of the Commission: Provided, That: (1) Appropriate entries shall be made in the maintenance log of the station showing the date and time the monitor was removed from and restored to service.
(3) The degree of modulation of the station shall be monitored with a cathode ray oscilloscope or other acceptable means.

Q. 22. When should minor corrections to the transmitter be made? Before or after logging the meter readings? (R & R 73.113)

A. Minor corrections to the transmitter should be made after

logging the meter readings.

Q. 23. What must a broadcast station do when it transmits matter for which it receives compensation? (R & R 73.119 and 73.289)

A. When a broadcast station transmits matter for which it receives or expects to receive any compensation such as money, services, or other consideration, the station must announce that the matter is sponsored or furnished and also announce the name of the sponsor. However, when a commercial product or service is advertised, use of the sponsor's corporate name, trade name, or name of the product or service will suffice if it is clear that the product name identifies the sponsor. Broadcast station licensees are responsible to insure that their employees or others connected with program material are fully aware that accurate sponsor identification must be obtained and broadcast. Sponsored programs and announcements that do not promote a specific commercial service or product must also be identified by the name of the actual sponsor. Operators keeping program logs must be alert to insure that sponsored matter is announced at the time of the broadcast and the sponsor is correctly identified in the program log.

Q. 24. When should an operator announce a program as "recorded? (R & R 73.1208)

A. Any taped, filmed or recorded program material in which time is of special significance, or by which an affirmative attempt is made to create the impression that it is occurring simultaneously with the broadcast, shall be announced at the beginning as taped, filmed or recorded. The language of the announcement shall be clear and in terms commonly understood by the public. For television stations, the announcement may be made visually or aurally.

Taped, filmed or recorded announcements which are of a commercial, promotional or public service nature, need not be identified as taped, filmed or recorded.

Q. 25. How often should the tower lights be checked for proper operation? (R & R 17.47 and 17.98)

A. Once each day, the operator is required to check for the proper operation of the tower lighting system. Most tower lighting systems are turned on and off with an automatic actuation switch controlled by a photocell. Stations using the photocell are required to burn the lights continuously if the automatic actuation switch does not operate properly. Any observed or otherwise known outage or improper functioning of a code or rotating beacon light or top light not corrected in 30 minutes should be reported by telephone or telegraph to the nearest Flight Service Station or office of the Federal Aviation Administration. Notice should also be given to the Flight Service Station or FAA office when the situation has been corrected.

Q. 26. What record is kept of tower light operation? (R & R 17.49)

A. The licensee of any radio station which has an antenna structure requiring illumination, shall make the following entries in the station record of the inspections:

(a) The time the tower lights are turned on and off each day, if manually controlled;

(b) The time the daily check of proper operation of the tower lights was made, if automatic alarm system is not provided;

(c) In the event of any observed or otherwise known failure of a tower light: (1) Nature of such failure. (2) Date and time the failure was observed, or otherwise noted. (3) Date, time and nature of the adjustments, repairs or replacements made. (4) Identification of Flight Service Station (Federal Aviation Agency) notified of the failure of any code or rotating beacon light or top light not corrected within 30 minutes, and the date and time such notice was given. (5) Date and time notice was given to the Flight Service Station (Federal Aviation Agency) that the required illumination was resumed.

(d) Upon completion of the periodic inspection required at least once each three months: (1) The date of the inspection and the condition of all tower lights and associated tower lighting control devices, indicators and alarm systems. (2) Any adjustments, replacements or repairs made to insure compliance with the lighting requirements, and the date such adjustments, replacements or repairs were made.

Q. 27. What is an Emergency Action Notification? (EAN) (R & R 73.907)

A. The Emergency Action Notification is the notice (with or without an Attack Warning) to all licensees and regulated services of the Federal Communications Commission and to the general public, of the existence of an Emergency Action Condition. The Emergency Action Notification is released upon direction of the President of the United States, and is disseminated only via the Emergency Action Notification System.

Q. 28. What is an Emergency Action Condition? (R & R 73.908)

A. An Emergency Action Condition is the condition which exists after the transmission of an Emergency Action Notification and before the transmission of the Emergency Action Termination. It is actually a national, state or local area emergency situation posing a threat to the safety of life or property.

Q. 29. What equipment must be installed in broadcast stations in regard to reception of an Emergency Action Notification? (R & R 73.933)

A. (a) All broadcast station licensees must install and oper-

ate, during their hours of broadcast operation, equipment capable of receiving Emergency Action Notifications or Terminations transmitted by other radio broadcast stations. This equipment must be maintained in operative condition, including arrangements for human listening watch or automatic alarm devices, and shall have its termination at each transmitter control point. However, where more than one broadcast transmitter is controlled from a common point by the same operator, only one set of equipment is required at that point.

(b) The off-the-air monitoring assignment of each standard, FM and television broadcast station is specified in the Detailed State Emergency Broadcast System (EBS) Operational Plan. Particular attention should be paid to avoiding "closed loops" in monitoring assignments.

(c) Prior to commencing routine operation or originating any emissions under program test, equipment test, experimental, or other authorizations or for any other purpose, licensees or permittees shall first ascertain whether an Emergency Action Condition exists and, if so, shall operate only in accordance with the Basic Emergency Broadcast System (EBS) Plan and Detailed State Emergency Broadcast System (EBS) Operational Plan.

Q. 30. How often should EBS test transmissions be sent? During what time period are they sent? (R & R 73.910, 73.961)

A. EBS test transmissions of the Emergency Action Notification System will be conducted by standard, FM and television broadcast stations once each week on an unscheduled basis, between the hours of 8:30 A.M. and local sunset. These tests will be conducted in accordance with procedures set forth in the EBS check list furnished to all broadcast stations.

Q. 31. During a period of an Emergency Action Condition, what should all non-participating stations do? (R & R 73.932(a))

A. Non-participating stations must observe radio silence.

Q. 32. (a) What is meant by the term "rebroadcast"? (b) What is the rule regarding the rebroadcasting of a program of another broadcasting station? (R & R 73.1207)

A. (a) The term "rebroadcast" means reception by radio of the programs of a radio station, and the simultaneous or subsequent retransmission of such programs by a broadcast station.

(b) No broadcasting station shall rebroadcast the program, or any part thereof, of another broadcasting station without the express authority of the originating station. A copy of the written consent, of the licensee originating the program shall be kept by the licensee of the station rebroadcasting such program, and shall be made available to the Commission upon request.

Q. 33. What are the rules with regard to broadcasting lottery information? (R & R 73.1211)

A. Broadcast stations are prohibited from transmitting announcements or programs promoting or containing information that would promote lotteries. A lottery is any scheme in which money or a prize of value is awarded to a person selected by lot or chance, if a condition of winning is that a person must have furnished any money, purchased a product or service, or have in his possession a product sold by the sponsor of a program broadcast on the station in question.

The provisions stated above do not apply to a lottery conducted by a State acting under authority of State law when such information is broadcast: (1) by a radio or television broadcast station licensed to a location in that State, or (2) by a radio or television broadcast station licensed to a location in an adjacent State which also conducts such a lottery. Such State "lottery" means the pooling of proceeds derived from the sale of tickets or chances and allotting those proceeds or parts thereof by chance to one or more chance takers or ticket purchasers. It does not include the placing or accepting of bets or wagers on sporting events or contests.

Q. 34. If a license or permit is lost, what action must be taken by the operator? What is the usual license term for radio operators? When may a license be renewed? (R & R 13.4, 13.11, 13.71 and 13.72)

A. See answers to Questions 4, 5 and 7 of Element 1, Series "O" and "M".

Q. 35. Where does an operator post his permit? (R& R 73.92, 73.264 and 73.564)

A. The operator must post his permit or posting statement at the place where he is on duty at the transmitter control point. FCC Form 759 is a posting statement used by operators employed at more than one station. The permit is posted at one station and FCC Forms 759 are posted at other stations where the operator is employed. The station license and other operating authorizations must be posted at the transmitter control point with all terms visible.

Q. 36. What is the rule regarding the broadcasting of a telephone conversation? (R & R 73.1206)

A. Before broadcasting a telephone conversation or recording a telephone conversation for later broadcast, the parties to the conversation must be informed of the intention to broadcast the conversation. However, station employees who may be presumed to be aware that their telephone conversations are intended for broadcast are not required to be advised of the broadcasting of their calls. Also, no notice of broadcast is required for per-

sons originating calls to programs which normally broadcast telephone conversations coming into the program.

Q. 37. What is a Subsidiary Communications Authorization? For what purpose is it used? (R & R 73.293, 73.295, 73.297, 73.593, 73.595 and 73.596)

A. A Subsidiary Communications Authorization (SCA) is a permit to use a subchannel within the main FM channel assignment.

In addition to monaural operation, FM stations may elect to broadcast stereo programming. This is accomplished by inserting a subchannel within the FM channel. In addition to the stereophonic subchannel, an entirely different subchannel may also be used. Programs transmitted by way of the Subsidiary Communications Authorization cannot be received without a special multiplex receiver. Most SCA subcarriers are used for the transmission of subscription background music, such as the music that is broadcast to stores and factories by Muzak. Other SCA uses are for detailed weather forecasting, special time signals, and other material of a broadcast nature expressly designed and intended for business, professional, educational, religious, trade, labor, agriculture or other groups engaged in any lawful activity.

Q. 38(a) What is the basic difference between directional antenna systems and non-directional antenna systems? (b) How does the radio operator determine that a directional antenna is radiating according to a specified pattern? (c) Discuss phase differences and current ratios with respect to directional antenna systems. (R & R 73.69, 73.95)

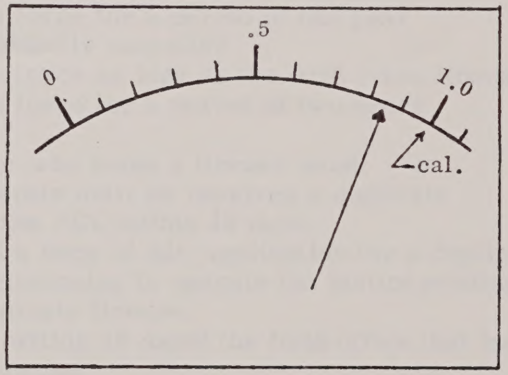
A. (a) Non-directional AM stations use a single antenna tower and transmit the radio signal with equal strength in all directions from the station. Directional AM stations utilize more than one antenna tower. By establishing the position of each tower, the power radiated by each tower, and the phase of the signal in each tower, different signal strengths can be radiated in various directions. Directional antenna systems are used to improve the signal over desired areas and to reduce the signal in the direction of other stations to prevent interference.

(b) To determine if a directional antenna system is radiating the signal according to a specified radiation pattern, an instrument called an antenna monitor is installed at the station. The antenna monitor enables the operator to determine if the radio frequency (RF) current in each tower is of the correct value and if the phase of the signal radiated by each tower is also correct. Some antenna monitors indicate the ratio of current in each tower to the current in one tower called the reference tower.

(c) A radio frequency signal or current is actually an alternating current. In addition to reversing itself continuously, its actual instantaneous value is varying from zero to a certain amount. If

the instantaneous peak values of the signals arrive at each tower at the exact same time, we say that the currents in each tower are "in phase" with each other. If the instantaneous peak values of the signals do NOT arrive at the towers at the exact same time, we say that the currents are "out of phase" with each other. The difference in time or phase is measured in degrees.

In most directional antenna systems, the currents in the various towers are out of phase with each other. The actual antenna currents (as read by ammeters), also tend to be different from each other. For each directional antenna tower, the station license contains a list of the required signal phases and antenna base current ratios. The antenna base current ratio for a tower is calculated by dividing the current meter reading for that tower by the current meter reading for the designated reference tower. The ratio, either calculated or read on the antenna monitor (see figure below), must not deviate more than 5 percent from the value on the station license. Operators on duty at AM stations, using directional antenna systems, should know how to read the antenna monitor meters, and should know how to use charts, tables or other instructions to determine if the station is operating correctly, if attention by the station's first class operator is required, or if the station must terminate operation.



Basic Antenna Current Ratio Meter.

The meter is set for "1.0" (cal.) by reading the current in the designated reference tower. The current is then taken for a given tower and its current ratio is then read on the meter. The meter can be in percentage or ratio. The above meter reads a ratio of .85.

FCC-TYPE EXAMINATION
ELEMENT 1

1. A response to a Notice of Violation must be made within:
   a. 10 days c. 3 days
   b. 24 hours d. 30 days

2. After receipt of a Notification of Suspension, the suspension order becomes effective within:
   a. 24 hours c. 3 days
   b. 30 days d. 15 days

3. The urgency signal is second in priority to:
   a. Communications relative to direction-finding bearings
   b. Communications preceded by a safety signal
   c. Distress calls, distress messages, and distress traffic
   d. Important international commerce bulletins

4. Corrections in the radio log may be made by:
   a. An operator licensed by the FCC
   b. The person who made the initial entry
   c. A notary public
   d. A person familiar with the operation of the installation

5. Radio stations are subject to inspection by:
   a. Any federal agency
   b. The Federal Bureau of Investigation
   c. The Federal Communications Commission
   d. The Federal Radio and Wire Authority

6. An application for renewal of a radio operator's license may be made:
   a. 15 months before expiration of the current license
   b. Within a year of expiration of the current license
   c. At all times, if there have been no violations
   d. Within 15 days of issuance of the original license

7. The secrecy provisions of the law do not apply to:
   a. Commercial bulletins
   b. Danish bulletins
   c. Holders of 1st Class Radiotelephone Operator's Licenses
   d. Distress messages

8. A response to a Notice of Violation must be addressed to:
   a. Any office of the Federal Communications Commission
   b. Any police authority of the continental United States
   c. The office of the FCC that originated the official notice
   d. The nearest Federal District Court

9. A person who has received an order of suspension may:
   a. Disregard the violation if he feels it to be unjust
   b. Request a hearing
   c. Order a court injunction on the FCC office
   d. Operate with an input power of less than 1 kilowatt

10. False signals of distress are:
    a. Allowed only if very low power is used
    b. Prohibited by law
    c. Common practical jokes among experienced operators
    d. Good tests of rescue facilities

11. Applicants for FCC licenses must generally be:
    a. Citizens of the United States only
    b. Citizens of the United States and Canada only
    c. Citizens of any country, provided they have held a radio operator's license of their respective country
    d. Citizens of English speaking countries

12. The usual license term for a radio operator is:
    a. one year c. three years
    b. two years d. five years

13. The second class radiotelephone license of a radio operator who qualifies for a first class license is:
    a. Kept in force for a period of one year
    b. Automatically cancelled
    c. Kept in force as long as the first class license is valid
    d. Kept in force for a period of two years

14. An operator who loses a license must:
    a. Not operate until he receives a duplicate
    b. Notify the FCC within 15 days
    c. Exhibit a copy of his application for a duplicate license while continuing to operate the station pending receipt of the duplicate license.
    d. Notify (within 10 days) the field office that issued the orginal license

15. Which of the following need not be done in correcting an error in a log:
    a. Indicate date of correction
    b. Indicate time of correction
    c. Initial the correction
    d. Strike out erroneous portion

16. Unidentified or superfluous radio communications may:
    a. Be transmitted on frequencies above 30 MHz.

b. Not be transmitted at all
c. Be transmitted on frequencies that are not used for distress, urgent or safety signals.
d. None of the above

17. A person who willfully violates a provision of the Communications Act of 1934 faces a penalty of:
a. Not more than $500 fine
b. Not more than $10, 000 fine
c. Not more than $10, 000 fine and imprisonment for a term not exceeding one year
d. Not more than $5, 000 fine and imprisonment for a term not exceeding two years

18. Any person who knowingly violates a rule made by the Federal Communications Commission, shall, in addition to other penalties provided by law, receive a fine of not more than:
a. $500 for each day during which the offense occurs
b. $1000 for each day during which the offense occurs
c. $50 for each day during which the offense occurs
d. None of the above

19. A licensee who receives a notice that he has violated an FCC rule, must:
a. Send a written answer to the FCC in Washington, D. C. within 10 days.
b. Send a written answer to the FCC in Washington, D. C. within 15 days
c. Send a written answer to the FCC office originating the notice within 10 days.
d. Send a written answer to the FCC office originating the notice within 15 days.

20. The FCC may not suspend an operator license upon proof that the licensee:
a. Has failed to carry out a lawful order of the master of the ship on which he is employed.
b. Has transmitted superfluous radio communications
c. Has assisted another to obtain an operator's license by fraudulent means
d. None of the above

FCC-TYPE EXAMINATION

ELEMENT 2—SERIES "O"

1. The word "OVER" indicates:
a. The conclusion of a series of transmissions
b. The station is leaving the air temporarily
c. The transmission is over and no response is expected
d. The transmission is over and a reply is expected

2. The system of substituting words for corresponding letters is known as:
a. The Dewey system
b. The substitute transmission method
c. The phonetic system
d. The safety-sending method

3. The word "OUT" means:
a. The station is being interfered with
b. The station is leaving the air
c. The transmission is ended and a response is expected
d. The transmission is concluded and no response is expected

4. Shouting into a microphone may cause:
a. Deattenuation
b. Amplification
c. Rectification
d. Overmodulation

5. When speaking into a microphone in a noisy location, it is good practice to:
a. Shield the microphone with the hands
b. Shout directly into the microphone
c. Turn down the audio gain control
d. Speak very softly

6. Unnecessary calling should be avoided since it may cause:
a. Overmodulation
b. Interference with other stations
c. Electro-magnetic decoupling
d. Antenna wear

7. In radiotelephony, the words "READ BACK" mean:
a. I am repeating my previous transmission
b. This transmission is being read
c. Repeat the entire message back to me exactly as you have received it
d. This is a "copied" transmission, not an original reading.

8. A separation between portions of a single transmission should be indicated by inserting the word:
   a. SEPARATE
   b. STOP
   c. BREAK
   d. SECURITY

9. The licensed operator of a ship's radiotelephone station exhibits his authority to operate by:
   a. Wearing a lapel pin with his registration number
   b. Printing circulars with his qualifications stated plainly
   c. Demonstrating proficiency in reception of American Morse Code
   d. Posting his license conspicuously at the principal location of the station

10. All calling should be:
    a. Lengthy and detailed
    b. Done on working frequencies
    c. Clear and concise
    d. Repeated several times

11. When voice transmissions are not being made, the transmitter should be:
    a. Dismantled
    b. Moved away from windows, air vents, etc.
    c. Kept on the air
    d. Kept off the air

12. If an operator is told that his voice is distorting, he should:
    a. Speak more softly or back away from the microphone
    b. Report the insult to the FCC
    c. Dismantle the modulator immediately
    d. Use A1 emission promptly

13. An operator will find specifications for obstruction marking and lighting for antenna towers in:
    a. The Communications Act of 1934
    b. Part 17 of the FCC Rules and Regulations
    c. The Geneva Radio Regulations of 1934
    d. The bulletins issued by the nearest FCC office

14. In the event of an emergency, an operator may:
    a. Increase his power in excess of the amount specified in the instrument of authorization
    b. Utilize his station in a manner other than that specified in the instrument of authorization
    c. Not utilize his station at all
    d. Transmit on frequencies other than those specified in the instrument of authorization

15. When a person other than the licensed operator speaks into a microphone, responsibility for proper operation of the station is borne by:
    a. The owner of the station
    b. The licensed operator in charge of the station
    c. The person himself, provided he is over 21 years of age
    d. The person himself, provided he is over 18 years of age

16. In radiotelephone communications, a common expression "Repeat" means:
    a. Speak slower
    b. Say again
    c. Repeat twice
    d. Use the phonetic alphabet

17. An operator who leaves his station unattended in a public place:
    a. Is not responsible for the transmitter when he is not present
    b. Must make it inaccessible to unauthorized persons
    c. Must always leave another licensed operator with the transmitter during daytime hours
    d. Must turn the transmitter off

18. An operator who hears profanity being used at his station need not:
    a. End the transmission
    b. Enter relevant details into the log
    c. Repeat the incident to the FCC
    d. Personally order a citizens arrest of the person uttering the profanity.

19. The word "Clear" when used in radiotelephone indicates that:
    a. The transmission is completed and no response is expected
    b. The immediately preceding message has been received and is completely understood
    c. The transmission is completed and a response is expected
    d. The next message has nothing to do with the previous message.

20. In testing a radiotelephone transmitter, an operator should not:
    a. Clearly indicate that he is testing
    b. Give the station call sign
    c. Interfere with other communications
    d. Test for as short a time as possible

FCC-TYPE EXAMINATION
ELEMENT 9

1. The percentage of modulation on negative peaks of frequent recurrence in an FM transmitter must not be more than:
   a. 50%　　c. 85%
   b. 75%　　d. 100%

2. 18 milliamperes is equal to:
   a. 18000 amperes　　c. 1.8 amperes
   b. .018 amperes　　d. .18 amperes

3. Using the indirect method, what is the operating power of a transmitter with an efficiency factor of 0.65, whose last RF stage has a plate voltage of 850 volts and a plate current of 60 ma.
   a. 33 watts　　c. 51 watts
   b. 33,150 watts　　d. 51,000 watts

4. Abbreviations may be used in a log:
   a. Only if the operator holds a first class radiotelephone license
   b. Only if they are approved FCC-type abbreviations
   c. If proper meaning or explanation is given elsewhere in the log
   d. Abbreviations may not be used in a log.

5. Corrections in a manually kept operating log may be made:
   a. only by the person making the original entry
   b. By persons competent to do so, having actual knowledge of the facts
   c. Only by the person in charge of the station
   d. Corrections may not be made in a log

6. Station logs must be retained for a period of:
   a. 1 year　　c. 3 years
   b. 2 years　　d. 5 years

7. Logs pertaining to communications involving a disaster must be retained for a period of:
   a. 2 years　　c. 5 years
   b. 3 years　　d. until authorized by the FCC to destroy them

8. The following must be included in a station identification:
   a. Call letters and location.
   b. Call letters.

c. Call letters, location and time.
d. Call letters and time.

9. In general, station identification must be made:
a. At the beginning and end of each time of operation.
b. Every 15 minutes.
c. Every 30 minutes.
d. At the beginning and end of each time of operation and hourly, as close to the hour as feasible during a natural break in the program.

10. The Standard Broadcast Band refers to the band of frequencies from:
a. 500 kHz to 1600 kHz.
b. 535 kHz to 1605 kHz.
c. 88 MHz to 108 MHz.
d. 550 kHz to 1700 kHz.

11. An operator must announce that a recorded program is in fact recorded:
a. If the program lasts at least one half minute.
b. Even if it is obvious to all that the program is recorded.
c. If an attempt is made to create the impression that it is occurring simultaneously with the broadcast.
d. An announcer need not indicate the fact that a particular program is recorded.

12. E B S stands for:
a. Emergency Broadcast System.
b. Energy Broadband System.
c. Electronic Broadcast Service.
d. None of the above.

13. E B S test transmissions should be sent at least:
a. Once a week.
b. Once a month.
c. Once each day.
d. Twice a week.

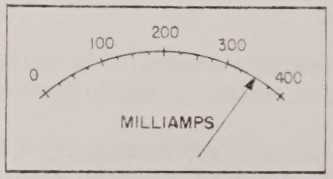
14. During a period of an Emergency Action Condition, non-participating stations:
a. Must continue their usual activity.
b. Must observe radio silence.
c. Must monitor specific stations.
d. Must keep their carriers on but stop modulation.

15. Tower lights shall be checked:
a. At least once each week.
b. At the beginning and end of each days activities.
c. At exactly one hour after sunset.
d. At least once each day.

16. If the tower lights fail, the operator must immediately notify the nearest:
a. Federal Aviation Agency office
b. Civil Air Patrol office
c. FCC office
d. E B S station

17. Which of the following exceeds the power limitations for a 25 kw. broadcast station?
a. 25.900 kw.
b. 23 kw.
c. 22, 600 watts
d. 26, 300 watts

18. The meter reads:
a. 350 amperes
b. 3.5 milliamperes
c. .35 amperes
d. 35 amperes



19. In making a log correction, the erroneous portion must be struck out, the corrections made, and:
a. the correction must be initialed.
b. the correction must be initialed and the date of correction must be entered.
c. the bottom of each page where corrections are made must be signed by the operator making the corrections.
d. slight corrections need not be initialed.

20. In the event of a malfunction of a part of the remote control equipment, the licensee:
a. must notify the nearest FCC office.
b. may operate for a period of 24 hours while repairs are being made.
c. must cease operation by remote control.
d. none of the above.

21. Using the direct method, what is the power of a broadcast station whose antenna resistance is 55 ohms, plate voltage of final stage is 2, 000 volts, plate current of final stage is 800 ma., antenna current is 5 A.?
a. 10, 000 W. b. 1280 W. c. 1600 W. d. 1375 W.

22. If the antenna base current ratio of an antenna tower (tower 1) is .4 and the base current of the reference tower (tower 2) is 5 amperes, what is the antenna base current in tower 1?
a. 0.8 A. b. 2 A. c. 1.25 A. d. 12.5 A.

23. Operator licenses may not be renewed:
a. during the final year of the license term.
b. within a year after the expiration of the license.
c. during the last two years of the license term.
d. none of the above.

24. A three -tower antenna system would be used at a:
a. non-directional station c. omnidirectional station
b. directional station d. tri-directional station

25. A "peak flasher" is used to indicate:
a. modulation peaks c. large frequency errors
b. current peaks d. excessive power

26. 850 volts is the same as:
a. 8,500 kilovolts c. 850,000 kilovolts
b. 0.85 kilovolts d. 8.5 kilovolts

27. What must an operator do if he notices an improper reading due to a malfunction of the remote control equipment?
a. he must cease operating.
b. he must switch his mode of operation.
c. he must reduce his power until the malfunction is corrected.
d. he must cease operating by remote control.

28. Where must an operator post his operator permit if he is employed at more than one station?
a. at his principal place of employment.
b. he need only post his permit at a station where he is the chief operator.
c. he must post his permit or special form at all stations where he is employed.
d. his permit must be kept in his possession at all times.

29. Programs transmitted by way of the Subsidiary Communications Authorization:
a. must be received with a special multiplex receiver.
b. are used only for the transmission of music.
c. make use of a subchannel inserted 25 kHz outside the main FM channel assignment.
d. must use monaural operation.

30. A broadcast station may transmit announcements promoting lotteries, provided:
a. the sponsor is not a profit-making organization.
b. the sponsor is a religious or fraternal organization.
c. the selection of the lottery winner is carefully supervised.
d. a broadcast station may not transmit announcements promoting lotteries.

31. When a commercial product is advertised, how must the sponsor be identified?
a. by his corporate name. b. by his trade name.
c. by the product name.
d. by any of the above, provided it is clear who the sponsor is.

32. An 8 watt FM broadcast station is required to log:
a. the plate voltage and current of the final stage.
b. the daily observations of the tower lights.
c. the antenna base current.
d. RF transmission line base reading.

33. If an operator's license is lost:
a. he must cease operating until his new license is received.
b. he must apply for a new license on FCC Form 736.
c. a copy of his duplicate license application must be posted.
d. he may continue to operate until his original license would have expired.

34. With regard to the broadcasting of telephone conversations:
a. all parties must be informed of the intention to broadcast their calls.
b. persons originating calls to programs that normally broadcast telephone conversations need not be notified.
c. only station employees need not be notified.
d. no one need be notified if the station is broadcasting to the general public.

35. Directional antenna systems do not generally:
a. reduce interference. b. use several towers.
c. have the currents in each tower in phase with each other.
d. increase the signal strength in the desired area.

36. What is the antenna base current ratio of an antenna tower if its base current is 7 amperes and the antenna base current in the reference tower is 4 amperes?
a. .57 b. 28 c. 1.75 d. 2.8

37. Using the indirect method, what is the operating power of a broadcast station if the plate voltage of the last stage is 1500 volts, plate current is 700 ma., and efficiency factor is .7?
a. 1050 watts b. 735 watts c. 105 watts d. 7350 watts

38. 3.75 kilowatts are equal to:
a. 375 watts c. 0.0375 watts
b. 37.5 watts d. 3,750 watts

39. A third class operator with a broadcast endorsement may make repairs to:
a. prevent voltage fluctuations in the primary power supply.
b. correct directional antenna malfunction.
c. the antenna phasor equipment. d. none of the above

40. If the operation of a transmitter is by remote control, what percentage of the remote controls and instruments must be readily accessible?
a. 50% b. 100% c. 75%
d. 100% of those dealing with power and frequency.

ANSWERS TO
FCC-TYPE EXAMINATIONS

ELEMENT 1

1. a
2. d
3. c
4. b
5. c
6. b
7. d
8. c
9. b
10. b
11. a
12. d
13. b
14. c
15. b
16. b
17. c
18. a
19. c
20. d

ELEMENT 2—SERIES "O"

1. d
2. c
3. d
4. d
5. a
6. b
7. c
8. c
9. d
10. c
11. d
12. a
13. b
14. b
15. b
16. b
17. b
18. d
19. a
20. c

ELEMENT 2—SERIES "M"

1. d
2. d
3. b
4. b
5. a
6. b
7. a
8. b
9. a
10. d
11. b
12. c
13. c
14. c
15. c
16. d
17. d
18. b
19. b
20. a

ELEMENT 9

1. d
2. b
3. a
4. c
5. a
6. b
7. d
8. a
9. d
10. b
11. c
12. a
13. a
14. b
15. d
16. a
17. d
18. c
19. b
20. c
21. d
22. b
23. c
24. b
25. a
26. b
27. d
28. c
29. a
30. d
31. d
32. b
33. c
34. b
35. c
36. c
37. b
38. d
39. d
40. b

WAMH-FM

AMHERST COLLEGE RADIO

Do not write inside

WAMH-FM

AMHERST COLLEGE RADIO

ELEMENT 1
SERIES "O" AND "M"

Question 1. Where and how are FCC licenses and permits obtained? (R&R 13.11(a))

Answer 1. An operator's license or permit may be obtained by applying for a specific license at a regional office of the Federal Communications Commission. An examination must then be taken by the applicant, and if the examination is completed satisfactorily, a license is then issued to the applicant. An applicant for a restricted radiotelephone permit must fill out an application, but he is not required to take an examination.

Q. 2. When a licensee qualifies for a higher grade of FCC license or permit, what happens to the lesser grade license? (R&R 13.26)

A. 2. If the holder of a license qualifies for a higher class in the same group, the license held will be cancelled upon the issuance of the new license. Similarly, if the holder of a restricted operator permit qualifies for a first- or second-class operator license of the corresponding type, the permit held will be cancelled upon issuance of the new license.

Q. 3. Who may apply for an FCC license? (R&R 13.5(a))

A. 3. Normally, commercial licenses are issued only to citizens and other nationals of the United States. As an exception, in the case of an alien who holds an Aircraft Pilot Certificate issued by the Civil Aeronautics Administration or the Federal Aviation Agency and is lawfully in the United States, the Commission, if it finds that the public interest will be served thereby, may waive the requirement of the U. S. nationality.

Q. 4. If a license or permit is lost what action must be taken by the operator? (R & R 13.71, 13.72)

A. 4. He must immediately notify the FCC, and may then apply for a duplicate license. He must inform the Federal Communications Commission of the circumstances surrounding the loss of the original license, or how said license was destroyed. He must state that a reasonable search has been made for the original license, and that if it is found subsequent to the issuance of a duplicate, he will return either the original or the duplicate to the FCC for cancellation. He also must submit documentary evidence of the service performed under the original license.

Pending receipt of the duplicate license, the operator may operate the station, but he must exhibit a signed copy of the application (FCC Form 756) for the duplicate license.

Q. 5. What is the usual license term for radio operators? (R & R 13.4(a))

A. 5. Commercial operator licenses will normally be issued for a term of five years from the date of issuance.

Q. 6. What government agency inspects radio stations in the U.S.? (Sec. 303(n))

A. 6. The Federal Communications Commission.

Q. 7. When may a license be renewed? (R & R 13.11)

A. 7. It may be renewed at any time during the final year of the license term or during a one-year period of grace after the date of expiration of the license sought to be renewed. This is done by submitting Form 756 to the nearest FCC field office. If the renewal application is submitted before the license expires, the operator may continue to operate. However, he must post a duplicate copy of the renewal application in lieu of the original license, since the original license must accompany the application. During the one year period of grace, the expired license is not valid until the new license has been issued.

Q. 8. Who keeps the station logs? (R & R 73.111)

A. 8. Each log shall be kept by the person or persons competent to do so, having actual knowledge of the facts required.

Q. 9. Who corrects errors in the station logs? (R & R 73.111)

A. 9. Any necessary correction may be made only by the person originating the entry.

Q. 10. How may errors in the station logs be corrected? (R & R 3.111)

A. 10. Any necessary correction may be made only by the person originating the entry who shall strike out the erroneous portion, initial the correction made, and indicate the date of correction.

Q. 11. Under what conditions may messages be rebroadcast? (Sec. 325(a))

A. 11. Messages may be rebroadcast only with the express authority of the originating station.

Q. 12. What messages and signals may not be transmitted? (R & R 13.66, 13.67, 13.68)

A. 12. No licensed radio operator shall transmit unnecessary, unidentified, or superfluous radio communications or signals. Neither shall he transmit communications containing obscene, indecent or profane words, language, or meaning. A licensed radio operator is prohibited from transmitting false or deceptive signals or communications by radio, or any call letter or signal which has not been assigned by proper authority to the radio station he is operating.

Q. 13. May an operator deliberately interfere with any radio communication or signal? (R & R 13.69)

A. 13. No.

Q. 14. What type of communication has top priority in the mobile service? (ART.)

A. 14. Distress calls, distress messages and distress traffic have top priority in the mobile service. Urgent signals are next in the order of priority, followed by safety signals.

Q. 15. What are the grounds for suspension of operator licenses? (Sec. 303(m)(1))

A. 15. The FCC may suspend an operator license upon proof sufficient to satisfy the Commission that the licensee:

(a) Has violated any provision of any Act, treaty or convention binding on the United States, which the Commission is authorized to administer, or any regulation made by the Commission under any such Act, treaty, or convention; or

(b) Has failed to carry out a lawful order of the master or person lawfully in charge of the ship or aircraft on which he is employed; or

(c) Has willfully damaged or permitted radio apparatus or installations to be damaged; or

(d) Has transmitted superfluous radio communications or signals or communications containing profane or obscene words, language, or meaning, or has knowingly transmitted ---

(1) False or deceptive signals or communications, or

(2) A call signal or letter which has not been assigned by proper authority to the station he is operating; or

(e) Has willfully or maliciously interfered with any other radio communications or signals; or

(f) Has obtained or attempted to obtain, or has assisted another to obtain or attempt to obtain, an operator's license by fraudulent means.

Q. 16. When may an operator divulge the contents of an intercepted message? (Sec. 605)

A. 16. An operator may divulge the contents of an intercepted message if the message is for the use of the general public or relating to ships in distress.

Q. 17. If a licensee is notified that he has violated an FCC rule or provision of the Communications Act of 1934, what must he do? (R & R 1.76)

A. 17. Within 10 days from receipt of notice, or such other period as may be specified, the licensee shall send a written answer, in duplicate, direct to the office of the Commission originating the official notice. If an answer cannot be sent or acknowledgment made within such 10-day period by reason of illness or other unavoidable circumstances, acknowledgment and answer shall be made at the earliest practicable date with a satisfactory explanation of the delay. The answer to each notice shall be complete in itself and shall not be abbreviated by reference to other communications or answers to other notices. In every instance, the answer shall contain a statement of action taken to correct the condition or omission complained of and to preclude its recurrence. In addition: (1) If the notice relates to violations that may be due to the physical or electrical characteristics of transmitting apparatus and any new apparatus is to be installed, the answer shall state the date such apparatus was ordered, the name of the manufacturer, and the promised date of delivery.

Q. 18. If a licensee receives a notice of suspension of his license, what must he do? (R & R 1.72)

A. 18. If a licensee receives a notice of suspension of his license, he must make a written application to the Commission within 15 days of receipt of the notice for a hearing on the suspension order.

Q. 19. What are the penalties provided for violating a provision of the Communications Act of 1934 or a Rule of the FCC? (Sec. 501, 502)

A. 19. Any person who willfully and knowingly violates the Communications Act of 1934 shall, upon conviction thereof, be punished for such offense, for which no penalty (other than a forfeiture) is provided in this Act, by a fine of not more than $10,000 or by imprisonment for a term not exceeding one year, or both; except that any person, having been once convicted of an offense punishable under this section, who is subsequently convicted of violating any provision of this Act punishable under this section, shall be punished by a fine of not more than $10,000 or by imprisonment for a term not exceeding two years; or both.

Any person who willfully and knowingly violates any rule, regulation or restriction made by the Commission under authority of this Act, or any rule, regulation or restriction made by any international communications treaty to which the United States is or may hereafter become a party, shall, in addition to any other penalties provided by law, be punished, upon conviction thereof, by a fine of not more than $500 for each and every day during which such offense occurs.

Q. 20. Define "harmful interference". (ART.)

A. 20. Harmful interference is any emission, radiation or induction which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunication service.

ELEMENT 2 — SERIES "O"

Ques. 1. What should an operator do when he leaves a transmitter unattended?

Ans. 1. Precautions should be taken so that the equipment will not be subjected to use by unauthorized personnel.

Q. 2. What are the meanings of: clear, out, over, roger, words twice, repeat, and break?

A. 2(a). "Clear" indicates that the transmission is completed, and that no response is expected.
(b) "Out" is similar in meaning to "clear". It indicates that the conversation is ended and no response is expected.
(c) "Over" indicates that the transmission has ended and a response is expected.
(d) "Roger" indicates that the immediately preceding message has been received, and is completely understood.
(e) "Words twice" is used to indicate that a series of words will be sent two times due to poor reception conditions or general communications difficulty.
(f) "Repeat" means to say again.
(g) The term "break" is used as a separation between parts of a single message.

Q. 3. How should a microphone be treated when used in noisy locations?

A. 3. It is good practice for the operator to shield the microphone with his hands when speaking into a microphone in a noisy location. This tends to cut down the microphone's picking up of background noise.

Q. 4. What may happen to the received signal when an operator has shouted into a microphone?

A. 4. Shouting into the microphone generally causes overmodulation. This results in speech distortion, as well as interference with stations on adjacent frequencies.

Q. 5. Why should radio transmitters be "off" when signals are not being transmitted?

A. 5. The transmitter should be off to prevent causing interference to other stations on the frequency.

Q. 6. Why should an operator use well-known words and phrases?

A. 6. Simple phrases and plain language are easier to understand. This reduces the number of errors that are made, and minimizes the amount of repetition necessary.

Q. 7. Why is the station's call sign transmitted?

A. 7. A station's call sign is transmitted so as to enable one to identify the station and thus avoid possible confusion. A proper station identification consists of the call letters and location of the station.

Q. 8. Where does an operator find specifications for obstruction marking and lighting (where required) for the antenna towers of a particular radio station?

A. 8. If an operator wishes to determine the specifications for obstruction marking and lighting of antenna towers, he should look in Part 17 of the Rules and Regulations of the FCC. If he wishes to determine the specifications for a particular station, he should examine the station authorization issued by the Commission.

Q. 9. What should an operator do if he hears profanity being used at his station?

A. 9. The licensed operator on duty should endeavor to end the transmission and should enter the relevant details in the log of the station. A report of the incident should be submitted to the FCC.

Q. 10. What should an operator do if the station he is calling does not answer within a reasonable length of time?

A. 10. He should stop calling and wait a reasonable length of time before attempting to call again. Continuous calling without results only causes interference and takes up valuable airways space that could be used by others.

Q. 11. When may an operator use his station without regard to certain provisions of his station license? (R & R 2.405)

A. 11. The licensee of any station, except amateur, may, during a period of emergency in which normal communication facilities are disrupted as a result of hurricane, flood, earthquake or similar disaster, utilize such station for emergency communication service in communicating in a manner other than that specified in the instrument of authorization: Provided: (a) That as soon as possible after the beginning of such emergency use, notice be sent to the Commission at Washington, D. C., and to the Engineer in Charge of the district in which the station is located, stating the nature of the emergency and the use to which the station is being put, and (b) That the emergency use of the station shall be discontinued as soon as substantially normal communication facilities are again available, and (c) That the Commission at Washington, D. C., and the Engineer in Charge shall be notified immediately

when such special use of the station is terminated.

Q. 12. Who bears the responsibility if an operator permits an unlicensed person to speak over his station?

A. 12. When a licensed operator in charge of a radiotelephone station permits another person to use the microphone and talk over the facilities of the station, he should remember that he continues to bear the responsibility for the proper operation of the station.

Q. 13. What is meant by a "phonetic alphabet" in radiotelephone communications?

A. 13. A phonetic alphabet is one in which a specific word is used to represent a letter of the alphabet; each letter has its corresponding word. For instance, the letter "A" may be made more easily recognizable by means of the word "Able", the word "Baker" is used to signify the letter "B", and the letter "C" is distinguished by use of the word "Charlie". By using one of the established phonetic symbols, the transmitting station makes clear to the receiving station exactly what letter is meant. This cuts down greatly on the amount of confusion and error, since many letters of the alphabet are similar in sound and may easily be confused.

Q. 14. How does the licensed operator of a station normally exhibit his authority to operate the station?

A. 14. An operator normally exhibits his authority to operate a station by posting a valid operator license or permit at the transmitter control point.

Q. 15. What precautions should be observed in testing a station on the air?

A. 15. In testing a radiotelephone transmitter, the operator should clearly indicate that he is testing, and the station call sign or name of the station, as required by the rules, should be clearly given. Tests should be as brief as possible. Caution should be observed by persons testing a station to make certain their test message will not interfere with other communications in progress on the same channel. Testing is important since it tells the operator whether the equipment is functioning properly. One of the primary duties of the operator is to maintain the equipment in proper operating condition.

ELEMENT 9

In recent years, Radiotelephone Third Class Operators with Broadcast Endorsements, have been given expanded privileges and duties. Some of these duties are somewhat technical in nature. To keep pace with these expanded duties, the FCC requires the Third Class Operator, with a Broadcast Endorsement, to have more technical knowledge than was previously required. The scope of the Element 9 examination has therefore been expanded to include additional technical and semi-technical questions.

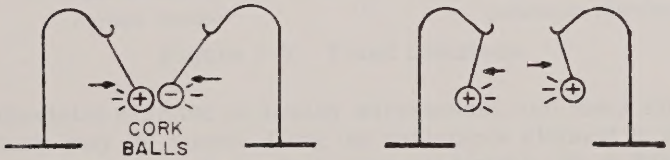
Previous editions of this book contained only the questions and answers given on Page 29. To meet the demand for the additional required knowledge, we are presenting the following basic information on radio theory. The prospective operator should be thoroughly familiar with the material contained in the questions and answers, as well as the basic radio theory.

The information in this book is sufficient for the prospective third class operator. However, if more technical information is desired, the AMECO "Commercial Radio Operator Theory Course" or "Radio Electronics Made Simple" publications can be consulted. These books are described on the back cover of this book.

BASIC RADIO THEORY

1-1 MATTER AND ELECTRICITY

Matter is a general term used to describe all the material things about us. Matter includes all man-made structures, woods, metals, gases, etc.; in other words, everything tangible. All matter, regardless of its size, quality or quantity, can be broken down fundamentally into two different types of particles. These particles, which are too small to be seen under a powerful microscope, are called ELECTRONS and PROTONS. Electrically, we say that the ELECTRON is NEGATIVELY charged and the PROTON is POSITIVELY charged. Also, the proton is about 1800 times as heavy as the electron.



A. Unlike charges attract. B. Like charges repel.

Figure 1-1. Attraction and repulsion.

1-2 THE LAW OF ELECTRIC CHARGES

Any object, such as a piece of glass, normally has a neutral or zero charge; that is, it contains as many electrons as protons. If this piece of glass can be made to have an excess of electrons, it is said to be negatively charged. Conversely, if the piece of glass can somehow be made to have a deficiency of electrons, the protons will predominate, and it is then said to be positively charged.

If a positively charged body is brought near a negatively charged body, the two objects will be drawn together. On the other hand, if two positively charged bodies or two negatively charged bodies are brought near each other, they will try to move away from each other. This reaction is the basis for our first law of electricity - the LAW OF ELECTRIC CHARGES. The law states "like charges repel, unlike charges attract". This law is illustrated by Figures 1-1A and 1-1B. In Figure 1-1A, a positively charged ball of cork is suspended by a piece of string near a negatively charged ball of cork. The two bodies swing toward each other since they attract each other. Figure 1-1B illustrates the two positively charged balls repelling each other.

1-3 DIFFERENCE OF POTENTIAL

If we were to connect a copper wire between the negative and the positive balls of cork, an electron flow would result. This is illustrated in Figure 1-2. The excess electrons from the negative ball would flow onto the positive ball where there is an electron deficiency and therefore, an attraction for the electrons. This flow continues until the deficiency and excess of electrons has disappeared and the balls become neutral or uncharged. This flow of electrons between the two differently charged bodies is caused by the difference in charge. A difference in charge between two objects will always result in the development of an electrical pressure between them. It is this electrical pressure that causes a current flow between these two bodies when they are connected by a piece of copper wire. This electrical pressure is defined as a DIFFERENCE OF POTENTIAL. The words "POTENTIAL" and "CHARGE" have similar meanings.

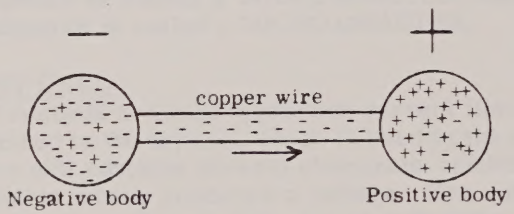


Figure 1-2. Flow of electrons.

1-4 CONDUCTORS AND INSULATORS

Materials through which current can easily flow are called CONDUCTORS. Most metals are good conductors. Conductors incorporate a large number of free electrons in their atomic structure. These free electrons are not held tightly and will move freely through the conductor when stimulated by external electrical pressure. Examples of good conductors, in the order of their conductivity, are silver, copper, aluminum and zinc.

Those materials through which current flows with difficulty are called INSULATORS. The electrons are tightly held in the atomic structure of an insulator and, therefore, cannot move about as freely as in conductors. Examples of insulators are wood, silk, glass and bakelite.

1-5 RESISTANCE

The ability of a material to oppose the flow of current is called RESISTANCE. All materials exhibit a certain amount of resistance to current flow. In order to compare the resistances of various materials, we require some standard unit of resistance measurement. The unit of resistance that was adapted for this purpose was the OHM, and the Greek letter Ω is its symbol. 1 ohm is defined as the amount of resistance inherent in 1, 000 feet of #10 copper wire. For example, 5, 000 feet of #10 copper wire would have a resistance of 5 ohms, 10, 000 feet of #10 copper wire would have 10 ohms, etc. Although the ohm is the basic unit, the MEGOHM, meaning 1, 000, 000 ohms, is frequently used. The instrument used to measure resistance is the OHMMETER.

1-6 RESISTORS

The resistor is a common radio part with a built-in specific amount of resistance. Resistors which are made of mixtures of carbon and clay are called carbon resistors. Carbon resistors are used in low power circuits. Wire wound resistors, which contain special resistance wire, are used in high power circuits. Figure 1-3 illustrates several types of fixed resistors which are used in radio circuits, together with the symbol which is used to represent them in circuit diagrams. When it becomes necessary to vary the amount of resistance in a circuit, we use adjustable and VARIABLE RESISTORS.

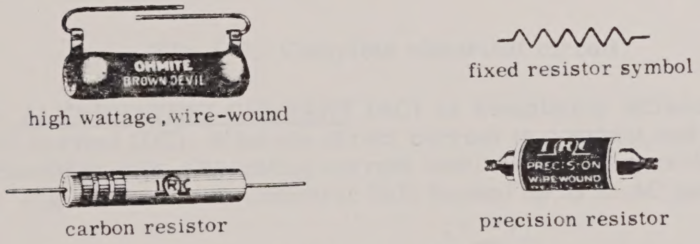
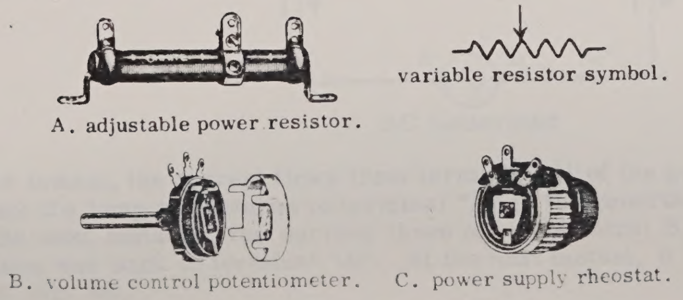


Figure 1-3. Fixed resistors.

The adjustable resistor is usually wire-wound, and has a sliding collar which may be moved along the resistance element to select any desired resistance value. It is then clamped in place. Figure 1-4A shows an adjustable resistor.



A. adjustable power resistor.

B. volume control potentiometer. C. power supply rheostat.

Figure 1-4. Variable resistors.

Variable resistors are used in a circuit when a resistance value must be changed frequently. Variable resistors are commonly called potentiometers or rheostats, depending upon their use. The resistance is varied by sliding a metal contact across the resistance in such a way so as to get different amounts of resistance. The volume control in a radio is a typical example of a variable resistor. Figure 1-4 B shows a potentiometer used as a volume control for a radio receiver; Figure 1-4 C shows a potentiometer wound of heavier wire for use in a power supply circuit.

1-7 VOLTAGE AND CURRENT

Voltage is another term for the difference of potential or electrical pressure which we spoke about in a preceding paragraph. It is the force which pushes or forces electrons through a wire, just as water pressure forces water through a pipe. Some other terms used to denote voltage are EMF (electro-motive force), IR DROP and FALL OF POTENTIAL. The unit of voltage is the VOLT and the instrument used to measure voltage is the VOLTMETER. The KILOVOLT is equal to 1000 volts.

Current is the flow of electrons through a wire as a result of the application of a difference of potential. If a larger amount of electrons flow past a given point in a specified amount of time, we have a greater current flow. The unit of current is the AMPERE; it is equal to 6, 300, 000, 000, 000, 000, 000 electrons flowing past a point in one second. MILLIAMPERE and MICROAMPERE are terms used to denote one-thousandth and one-millionth of an ampere, respectively. Current is measured by an AMMETER. A meter whose scale is in milliamperes is called a MILLIAMMETER, and a meter that reads microamperes is called a MICROAMMETER.

1-8 THE DRY CELL

Several methods are used to produce current flow or electricity. A common method is the dry cell, which is used in the ordinary flashlight. The dry cell contains several chemicals combined to cause a chemical reaction which produces a voltage. The voltage produced by all dry cells, regardless of size, is 1-1/2 volts. A battery is composed of a number of cells. Therefore, a battery may be 3 volts, 6 volts, 7-1/2 volts, etc., depending upon the number of cells it contains. The fact that a cell is larger than another one indicates that the larger cell is capable of delivering current for a longer period of time than the smaller one. Figure 1-5 illustrates a typical 1-1/2 volt cell and a 45 volt battery. The 45 volt battery contains 30 cells.

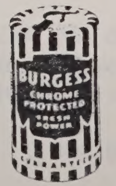


Fig. 1-5A. 1-1/2 v. flashlight cell.

BURGESS
BATTERY

Fig. 1-5B. 45 v. "B" battery.

Every cell has a negative and a positive terminal. The electrons leave the cell at the negative terminal, flow through the circuit, and return to the cell at the positive terminal. This type of current flow is known as DIRECT CURRENT (DC). Direct current flows only in ONE direction.

1-9 ELECTRICAL CIRCUITS

Figure 1-6 is a diagram of a complete electrical circuit. The arrows indicate the direction of the current flow. As long as we can trace the current from the negative point of the cell, all around the circuit and back to the positive point, we have a complete circuit. The important thing to remember is that current will only flow through a complete circuit.

The necessary parts for a complete circuit are:

(1) A source of voltage - the dry cell in Figure 1-6.
(2) Connecting leads - the copper wire conductors in Figure 1-6.
(3) A load - the bulb in Figure 1-6.

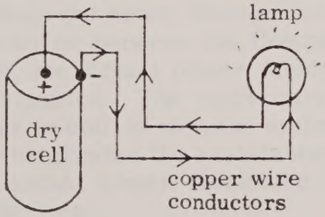
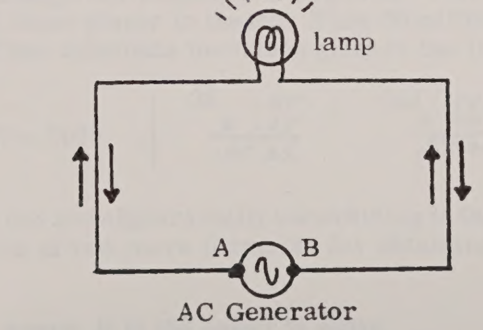


Fig. 1-6. Complete electrical circuit.

1-10 ALTERNATING CURRENT (AC) is completely different from direct current (DC). Whereas direct current is constant and flows in one direction only, alternating current continuously changes its direction. Fig. 1-7 shows an electric bulb hooked up to an AC generator.

Figure 1-7.



At one instant, the current flows from terminal "A" of the generator, through the lamp and returns to terminal "B" of the generator. During the next instance, the current flows out of terminal B, through the lamp and back to terminal "A". At the next instant, it reverses itself, etc. etc.

Not only does alternating current reverse itself, as described above, it also continuously varies in strength from zero to some peak value. When an AC voltmeter reads AC voltage, it obviously does not read the instantaneous fluctuations; it reads its effective value.

Alternating current can be generated mechanically by an AC generator. It can also be generated by electronic means-by various tube and transistor circuits. Both AC and DC are present in a transmitter. However, the signal at the antenna that is to be transmitted is AC.

FREQUENCY. The flow of alternating current, first in one direction, then in the opposite direction, is called a complete "cycle". The frequency of alternating current is the number of complete cycles that occur in one second. The unit of frequency is cycles per second or simply cycles. The abbreviation for cycles per second is CPS. In recent years, the term "Hertz" (abbreviated "Hz"), has been used in place of cycles. The meter used to measure frequency is called a Frequency Meter.

The frequency of the AC power that is supplied to most homes in the United States is 60 Hertz. This is known as the POWER FREQUENCY. Radio waves transmitted by radio stations have a frequency much higher than the 60 Hz power frequency. Their frequency is generally above 20,000 Hz. An electrical frequency higher than 20,000 Hz is known as a RADIO FREQUENCY. The abbreviation for radio frequency is "RF".

Sound waves which can be heard by the human ear are called audible sounds or audio sounds. The frequency of the audio sounds lie in the range from 16 to 16,000 Hz. When a sound wave frequency is converted into an electrical frequency, it is known as an audio frequency (AF). For example, when our voice is amplified by a public address system, the sound waves from our throats strike the microphone and are converted into electrical frequencies, or audio frequencies.

When a frequency is given as a large number of Hz, it can be converted into smaller units of kiloHertz per second or MegaHertz per second, just as pennies can be converted into dollars. Example:

(a) 1,000 Hertz = 1 kiloHertz. The abbreviation for kiloHertz is "kHz". (The prefix kilo always means 1,000). Therefore, in order to convert Hertz into kiloHertz, we divide the number of Hertz by 1,000.

$$1,000,000 \text{ Hz} = \frac{1,000,000}{1,000} = 1,000 \text{ kHz}.$$

(b) 1,000,000 Hz = 1 MegaHertz. The abbreviation for MegaHertz is "MHz". Therefore, in order to convert Hertz into MegaHertz, we divide the number of Hertz by 1,000,000.

$$1,000,000 \text{ Hz} = \frac{1,000,000}{1,000,000} = 1 \text{ MHz}.$$

1-11 POWER

Whenever current flows through a resistance, there is friction

between the moving electrons and the molecules of the resistor. This friction causes heat to be generated, as does all friction. We could also say that electrical energy is changed to heat energy whenever current flows through a resistor. The unit of energy is the JOULE. The rate at which the heat energy is generated is the power that the resistor consumes. This power consumption in the form of heat represents a loss because we do not make use of the heat generated in radio circuits.

We should know how much heat power a resistor is consuming or dissipating. This is important because a resistor will burn up if it cannot stand the heat that is being generated by current flow. Resistors are, therefore, rated, not only in ohms, but in the amount of power that they can dissipate without overheating. The unit of electrical power is the WATT. A resistor rated at 5 watts is one which can safely dissipate up to 5 watts of power. If this resistor is forced to dissipate 10 watts, by increased current flow, it will burn up.

Exactly how much power is dissipated in a particular circuit, and upon what factors does the power dissipation depend? Since the power is the result of friction between the flowing electrons and the resistance in the circuit, the actual power dissipated depends upon the current and the resistance. The more current that flows, the more electrons there are to collide with the molecules of the resistance material. Also, the greater the resistance, the greater is the resulting friction. The actual power dissipated in a resistor can be found by the following formula:

$P = I^2 \times R$ (I^2 means $I \times I$)

where: P is the power in watts
I is the current in amperes
R is the resistance in ohms

Problem: Find the power dissipated in a 2000 ohm resistor with 50 milliamperes flowing through it.

Solution: First change milliamperes to amperes. This is done by moving the decimal three places to the left. Thus 50 milliamperes equals .05 ampere. Then substitute the values given in the formula.

(1) $P = I^2 \times R$
(2) $P = .05 \times .05 \times 2000$
(3) $P = 5$ watts

(1) $\begin{array}{r} .05 \\ \times .05 \\ \hline .0025 \end{array}$ (2) $\begin{array}{r} .0025 \\ \times 2000 \\ \hline 5.0000 \end{array}$

By using Ohm's law and algebraically substituting in the above formula, we can arrive at two more formulas for obtaining power dissipation.

$P = E \times I$

$P = \frac{E^2}{R}$

where: P is the power in watts,
E is the voltage in volts,
I is the current in amperes and
R is the resistance in ohms.

The Wattmeter is the instrument that is used to measure power. The Watt-hour meter is the instrument that is used to measure energy.

INTRODUCTION TO TRANSMISSION AND RECEPTION

The diagram in Figure 8 represents a bird's eye view of a complete communications system. Instead of drawing out the individual circuits, a series of boxes are drawn. Each box represents a stage. (A stage is a tube or transistor with its associated parts.) The function of each stage is printed inside the box. Such a diagram is known as a block diagram.

Fig. 8-A illustrates a block diagram of a radio-telephone transmitter. Let us see briefly what the function is of each stage outlined in the block diagram. The heart of the transmitter is the oscillator.

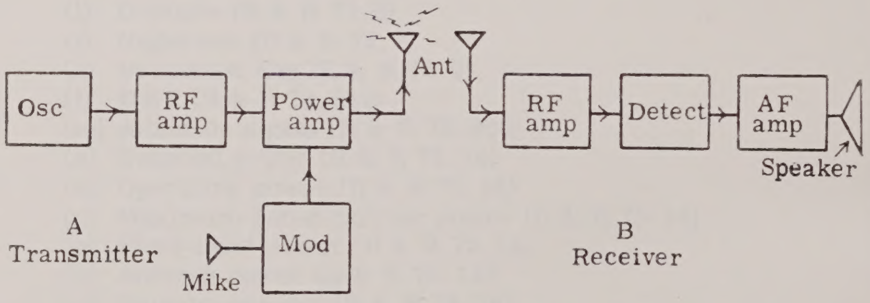


Figure 8. Radio transmitter and receiver.

Its sole purpose is to generate a high frequency alternating current. This high frequency AC is called radio frequency or RF. The output of the oscillator is fed to the radio frequency amplifier which simply amplifies the RF output from the oscillator. The output of the RF amplifier is then fed to the RF power amplifier. The RF power amplifier amplifies the RF in terms of power. The power amplifier then supplies the antenna with the RF power that is to be radiated into space. Up to this point, we have only discussed the generation and transmission of a radio frequency wave which, by itself, contains no intelligence. The intelligence that we desire to transmit is the audio in the form of voice or music. Let us see how the audio is radiated into space.

The function of the microphone is to convert sound energy into electrical energy. The output of the microphone is applied to the modulator, which is simply an audio amplifier. The modulator serves two functions: (1) it amplifies the weak audio output of the microphone and (2) it superimposes the audio onto the radio frequency energy that is present at the power amplifier stage, by a process called modulation. The audio is combined with the RF wave because an audio wave by itself is not capable of traveling through space. High frequency such as RF, however, is capable of traveling through space. Therefore, the RF acts as the "carrier" for the audio; the RF carries the audio from the transmitter to the receiver. The combined audio RF output of the power amplifier is fed to the antenna where it is radiated out into space in the form of electromagnetic waves.

At the receiving end of the communications system, the electro-

magnetic waves induce small voltages into the receiving antenna. These signal voltages are quite weak because the electromagnetic waves have travelled some distance before striking the receiving antenna. Therefore, the signal voltages must be amplified; this is the function of the first stage in the receiver called the RF amplifier. The output of this stage is applied to the detector. Just as the oscillator is the heart of the transmitter, the detector is the heart of the receiver. The detector stage separates the audio from the RF carrier. The carrier has served its purpose in bringing the audio to the receiver. Now, all we are interested in is the audio. The audio output of the detector is then fed to an audio amplifier stage to be amplified. The amplified audio is applied to a speaker which converts the audio electrical variations back into the original sound that energized the microphone of the transmitter.

ELEMENT 9*

Question 1. What is meant by the following words or phrases?
(a) Standard broadcast station (AM) (R & R 73.1)
(b) Standard broadcast band (R & R 73.2)
(c) Standard broadcast channel (R & R 73.3)
(d) FM station (R & R 73.310)
(e) FM band (R & R 73.310)
(f) FM Stereophonic Broadcast (R & R 73.310)
(g) FM Subsidiary Communications Authorization (SCA) (R & R 73.293)
(h) Sunrise and Sunset (R & R 73.8)
(i) Daytime (R & R 73.6)
(j) Nighttime (R & R 73.7)
(k) Broadcast day (R & R 73.9)
(l) EBS (R & R 73.912)
(m) Attention signal (R & R 73.906)
(n) Nominal power (R & R 73.14)
(o) Operating power (R & R 73.14)
(p) Maximum rated carrier power (R & R 73.14)
(q) Plate input power (R & R 73.14)
(r) Antenna power (R & R 73.14)
(s) Antenna current (R & R 73.14)
(t) Antenna resistance (R & R 73.14)
(u) Percentage modulation (amplitude) (R & R 73.14)

Answer 1(a). The term "standard broadcast station" (AM) means a broadcasting station licensed for the transmission of amplitude-modulated (voice type) emissions primarily intended to be received by the general public and operated on a channel in the band - 535 kiloHertz to 1605 kiloHertz.

(b) The term "standard broadcast band" means the band of frequencies between 535 kiloHertz and 1605 kiloHertz.

(c) The term "standard broadcast channel" means the band of frequencies occupied by the carrier and two side bands of a broadcast signal with the carrier frequency at the center. Channels shall be designated by their assigned carrier frequencies. The 107 carrier frequencies assigned to standard broadcast stations shall begin at 540 kiloHertz and be in successive steps of 10 kiloHertz.

(d) The term "FM station" means a station employing frequency modulation in the FM broadcast band and licensed primarily for the transmission of radiotelephone emissions intended to be received by the general public.

(e) The term "FM band" means the band of frequencies extending from 88 to 108 megaHertz, which includes those assigned to noncommercial educational broadcasting.

(f) The term "FM Stereophonic Broadcast" means the transmission of a stereophonic program by a single FM broadcast sta-

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*See note in Preface concerning Element 9 examination.

tion utilizing the main channel and a stereophonic subchannel.

(g) An "FM Subsidiary Communications Authorization" (SCA) is an authorization granted to an FM station for the simultaneous transmission of one or more signals on assigned subcarrier frequencies within the station's assigned channel. Special decoding equipment is required to receive program material furnished on the SCA subchannel. Such material, although broadcast related, is normally intended for paying subscribers.

(h) The terms "sunrise" and "sunset" mean, for each particular location and during any particular month, the time of sunrise and sunset as specified in the instrument of authorization. Specifying the times of sunrise and sunset on the station license is important because not all standard (AM) broadcast stations are permitted to operate at night. In order to control objectionable skywave interference, stations which are permitted to operate at night are frequently required to change their modes of operation. These changes may involve the use of directional antenna systems, a reduction in operating power, or both, and normally occur at the sunrise and sunset times, listed in the station license.

(i) The term "daytime" means the period of time between the local sunrise and the local sunset.

(j) The term "nighttime" means that period of time between local sunset and local sunrise.

(k) The term "broadcast day" means the period of time between local sunrise and 12 midnight, local standard time.

(l) "E B S" stands for Emergency Broadcast System. The Emergency Broadcast System consists of the facilities and personnel of nongovernment broadcast stations and interconnecting facilities which have been authorized by the Federal Communications Commission to operate in a controlled manner during a war, threat of war, state of public peril or disaster, or other national emergency.

(m) The "attention signal" is the signaling arrangement whereby standard, FM and television broadcast stations can actuate mute receivers for interstation receipt of emergency cueing announcements and broadcasts. It consists of two audio tones having fundamental frequencies of 853 and 960 Hertz and shall not vary over ±0.5 Hertz. The two tones, with specified frequency tolerances and harmonic distortion limits, modulate the transmitter simultaneously at no less than 40% for an automatic time period of not less than 20 seconds, nor longer than 25 seconds.

The total harmonic distortion of each of the audio tones shall not exceed 5%.

(n) "Nominal power" is the power of a standard broadcast station, as specified in a system of classification which includes the following values: 50 kW., 25 kW., 10 kW., 5 kW., 1 kW., 0.5 kW., 0.25 kW.

(o) Depending on the context within which it is employed, the term "operating power" may be synonymous with "nominal power" or "antenna power". The operating power for AM stations is normally the antenna input power and for FM stations, it is the transmitter output power.

(p) "Maximum rated carrier power" is the maximum power at which the transmitter can be operated satisfactorily, and is determined by the design of the transmitter and the type and number of vacuum tubes used in the last radio stage.

(q) "Plate input power" means the product of the direct plate voltage applied to the tubes in the last radio stage, and the total direct current flowing to the plates of these tubes, measured without modulation.

(r) "Antenna input power" or "antenna power" means the product of the square of the antenna current and the antenna resistance at the point where the current is measured.

(s) "Antenna current" means the radio-frequency current in the antenna with NO MODULATION.

(t) "Antenna resistance" means the total resistance of the transmitting antenna system at the operating frequency and at the point at which the antenna current is measured.

(u) "Percentage modulation" with respect to an amplitude modulated wave means the ratio of half the difference between the maximum and minimum amplitudes of the amplitude modulated wave to the average amplitude expressed in percentage.

Q. 2. Make the following transformations:
(a) Kilocycles to cycles. (c) Milliamperes to amperes.
(b) Kilovolts to volts. (d) Watts to kilowatts.

A. 2(a) One kilocycle (kc) is equal to 1,000 cycles (c). Therefore, in order to change kilocycles to cycles, we multiply by one thousand. In order to change cycles to kilocycles, we divide by one thousand. Examples: 3 kilocycles equals 3,000 cycles. 1.4 kilocycles equals 1,400 cycles. 500 cycles equals .5 kilocycle.

In recent years, the electronics industry has adopted the term "Hertz", abbreviated "Hz", to replace the term "cycles". Kilocycles has been replaced by "kiloHertz", abbreviated "kHz"; megacycles (meaning one million cycles), has been replaced by "Mega-Hertz", abbreviated "MHz".

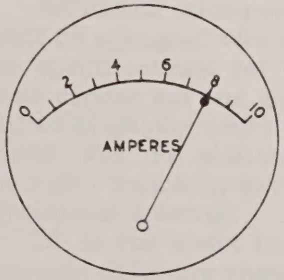
(b) One kilovolt is equal to 1,000 volts. Therefore, in order to change kilovolts (kv) to volts (v), we multiply by one thousand. In order to change volts to kilovolts, we divide by one thousand. Examples: 2.6 kilovolts equals 2,600 volts. 1 kilovolt equals 1,000 volts. 50 volts equals .050 kilovolt.

(c) One ampere is equal to 1,000 milliamperes. Therefore, in order to change milliamperes (ma.) to amperes (A), we divide by one thousand. In order to change amperes to milliamperes, we multiply by one thousand. Examples: 50 milliamperes equals .050 ampere. 200 milliamperes equals .2 ampere. .003 ampere equals

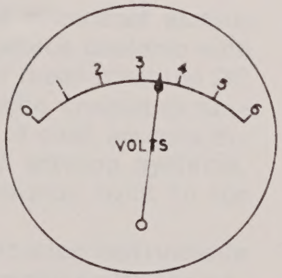
3 milliamperes.

(d) One kilowatt is equal to 1,000 watts. Therefore, in order to change watts to kilowatts, we divide by 1,000. In order to change kilowatts to watts, we multiply by 1,000. Examples: 3.4 kilowatts equals 3,400 watts. 250 watts equals .25 kilowatts.

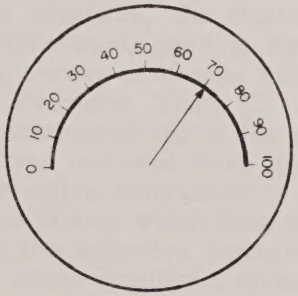
Q. 3. Draw the "face" of the following meters and know how to read each: (a) Ammeter. (b) Voltmeter. (c) Arbitrary scale meter. (d) Frequency monitor meter. (e) VU meter (for % modulation). (f) Milliammeter. (g) Antenna phase meter. (h) RF transmission line power meter.


0
2
4
6
8
10
AMPERES

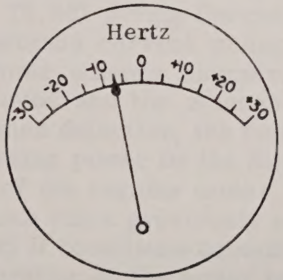
(a) Ammeter. Reading shown is 8 amperes.


0
2
3
4
5
6
VOLTS

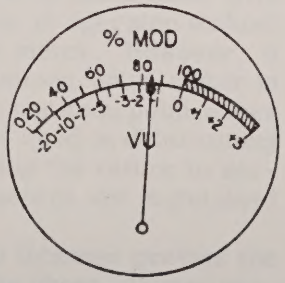
(b) Voltmeter. Reading shown is 3.5 volts.


0
10
20
30
40
50
60
70
80
90
100

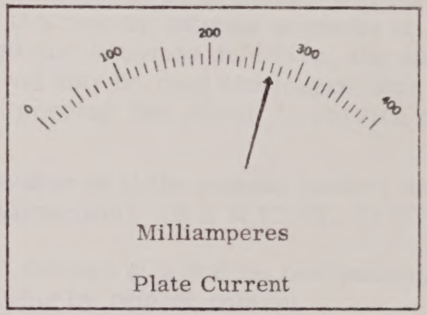
(c) Arbitrary scale meter.


Hertz
-30
-20
-10
0
+10
+20
+30

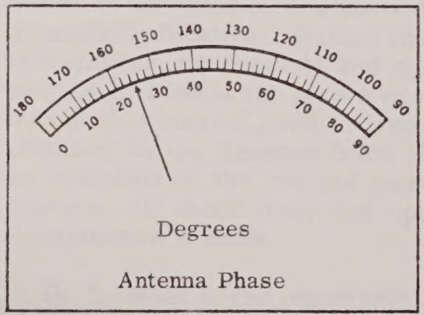
(d) Frequency Monitor Meter indicates deviation in Hertz. (kHz for FM stations) Reading shown is -7 Hertz.


% MOD
0
20
40
60
80
100
-20
-10
-7
-5
-3
-2
-1
0
+1
+2
+3
VU

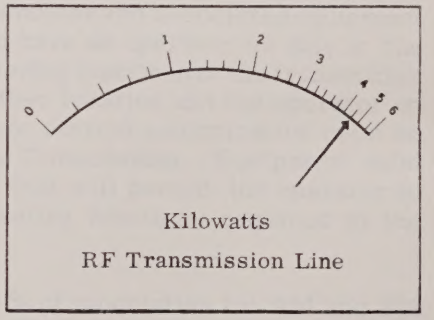
(e) VU Meter. For % modulation, scale is made larger than VU scale. Reading shown is 85% mod.


0
100
200
300
400
Milliamperes
Plate Current

(f) Milliammeter. Reading is 270 ma.


180
170
160
150
140
130
120
110
100
90
0
10
20
30
40
50
60
70
80
90
Degrees
Antenna Phase

(g) Antenna Phase Meter. Reading on bottom scale is 25 degrees.


0
1
2
3
4
5
6
Kilowatts
RF Transmission Line

(h) Transmission Line Wattmeter. Reading is 4.5 kilowatts.

Q. 4. What indicating instruments are found in a broadcast transmitter? What should an operator know about these instruments? (R & R 73.39, 73.58, 73.258, 73.558)

A. Each transmitter is equipped with meters to indicate plate voltage and plate current. These meters indicate the operating constants of the transmitter amplifier. Each transmitter has normal operating levels of plate voltage and plate current and the operator should know what corrective actions should be taken when the meters indicate abnormal values.

At the place in the circuit where the antenna resistance or common point resistance is measured, an antenna ammeter is inserted to measure current into the antenna system. This meter is a direct indication as to whether the station is operating at, above, or below the licensed power. This meter indication should be maintained as close as possible to the licensed operating current and the operator should know what actions are necessary when the meter indications deviate from that value. Usually the antenna ammeter is located at the base of the tower and not easily accessible to the operator on duty. For this reason, most stations use a remote antenna ammeter which is located at the normal operating position of the person on duty. The remote antenna ammeter in-

dication may be entered in the operating log, in lieu of the base current meter indication, provided the remote meter is calibrated once weekly.

All antenna current meters should be read when the transmitter is not being modulated. A break in programs is a good time to read the antenna current meters.

Q. 5. What should an operator do if the remote antenna ammeter becomes defective? (R & R 73.58)

A. If the remote antenna ammeter becomes defective, the antenna base currents may be read and logged once daily for each mode of operation, pending the return to service of the regular remote meter.

Additional information: (a) Each standard broadcast station shall be equipped with indicating instruments (which conform with the specifications set forth in Sec. 73.39) for measuring the DC plate circuit current and voltage of the last radio frequency amplified stage; the radio frequency base current of each antenna element; and, for stations employing directional antenna systems, the radio frequency current at the point of common input to the directional antenna.

(b) In the event that any one of these indicating instruments becomes defective when no substitute which conforms with the required specifications is available, the station may be operated without the defective instrument, pending its repair or replacement, for a period not in excess of 60 days without further authority of the Commission: Provided, That: (1) Appropriate entries shall be made in the maintenance log of the station, showing the date and time the meter was removed from and actually restored to service. (3) If the defective instrument is the antenna current meter of a nondirectional station which does not employ a remote antenna ammeter, or if the defective instrument is the common point meter of a station which employs a directional antenna, and does not employ a remote common point meter, the operating power shall be determined by the indirect method (in accordance with Sec. 73.52) during the entire time the station is operated without the antenna current meter or common point meter. However, if a remote antenna ammeter or a remote common point meter is employed and the antenna current meter or common point meter becomes defective, the remote meter may be used in determining operating power by the direct method, pending the return to service of the regular meter, provided other meters are maintained at same value previously employed.

(c) If conditions beyond the control of the licensee prevent the restoration of the meter to service within the above allowed period, informal request (in accordance with Sec. 1.549) may be filed with the Engineer-in-Charge of the radio district in which the station is located, for such additional time as may be required to complete repairs of the defective instrument.

(d) Remote antenna ammeters and remote common point meters are not required; therefore, authority to operate without them is not necessary. However, if a remote antenna ammeter or common point meter is employed and becomes defective, the antenna base currents (as stated above) may be read and logged once daily for each mode of operation, pending the return to service of the regular remote meter.

Q. 6. What should an operator do if the remote control devices at a station so equipped malfunction? (R & R 73.67, 73.274 and 73.575)

A. If the remote control devices at a station malfunction, the operator should cease operating by remote control.

Additional Information: Some broadcast stations have the main studio at one location and the transmitter and associated equipment at another location. Rather than have an operator on duty at the transmitter, the controls and metering functions of the transmitter may be located at the studio or other location and the operator on duty at this control point. A remote control authorization must be obtained by the licensee from the Commission. Equipment must be installed at the control point that will permit the operator to perform all monitoring and operating functions required by the Commission's rules.

Q. 7. What is the permissible % of modulation for AM and FM stations? (R & R 73.55, 73.268, 73.568)

A. Modulation in excess of 100% is called overmodulation. It is to be avoided because it causes interference in AM and FM transmission. It also causes distortion in AM transmission.

A low percentage of modulation is called undermodulation. Undermodulation is undesirable because it results in weak reception.

In both AM and FM, the percentage of modulation shall be maintained as high as possible, consistent with good quality of transmission and good broadcast practice.

In a standard (AM) broadcast station, the percentage of modulation is not to exceed 100% on negative peaks of frequent recurrence, or 125% on positive peaks at any time.

In FM, the percentage of modulation is not to exceed 100% on either positive or negative peaks of frequent recurrence.

In both AM and FM, the percentage of modulation should not be less than 85% on peaks of frequent occurrence; but where necessary to avoid objectionable loudness, modulation may be reduced to whatever level is necessary, even if the resulting modulation is substantially less than 85% on peaks of frequent occurrence.

Q. 8. What is the station requirement with respect to station monitors? (R& R 73.50, 73.56, 73.253, 73.268, 73.553, 73.568)

A. Each station must have in operation a modulation monitor which the operator uses to determine whether the modulation is at

the proper level. The modulation monitor consists of a meter and a peak flasher. The meter does not indicate the peak modulation, but indicates a value somewhat less than the peak modulation. The "peak flasher" indicates modulation peaks. Generally, the peak flasher is set so that when it flashes, it is an indication that the modulation is excessive and that corrective action must be taken by the operator.

Q. 9. What is the permissible frequency tolerance of standard broadcast stations? (R & R 73.59) Of FM stations? (R & R 73.269)

A. The operating frequency of each AM broadcast station should be maintained within 20 Hertz of the assigned frequency. The center frequency of each FM broadcast station should be maintained within 2,000 Hertz of the assigned center frequency.

Q. 10(a) How is the operating power of a standard broadcast station determined? (R & R 73.51) (b) What is the operating power of a normally operating standard (AM) broadcast station having a final plate voltage of 800 volts, a final plate current of 1000 ma., an antenna resistance of 52 ohms, an antenna current of 3.2 amperes and an F factor of 0.7. (c) How is the operating power of an FM station determined? (R & R 73.267) (d) Using the indirect method, what is the operating power of the above transmitter?

A. (a) (1) Except as provided in paragraph (2) of this section, the operating power shall be determined by the direct method (the square of the antenna current times the antenna resistance at the point where the current is measured and at the operating frequency). For example, if the antenna current is 4.2 amperes and the antenna resistance is 48 ohms, the operating power is:

$$4.2^2 \times 48 = 4.2 \times 4.2 \times 48 = 846.7 \text{ watts}$$

Non-directional AM broadcast stations employ only a single antenna tower. Power determined by the direct method is equal to the product of the antenna resistance and the square of the antenna current. Directional AM broadcast stations employ multiple radiating elements. Power determined by the direct method for these stations is equal to the product of the resistance common to all antenna towers (common point resistance) and the square of the current common to all antenna towers (common point current). At FM broadcast stations, if power is determined by the direct method, it is read directly from the RF transmission line meter. This meter must be calibrated each six months to give a direct indication of the power supplied to the antenna.

(2) Operating power shall be determined on a temporary basis by the indirect method: (i) In the case of an emergency where the licensed antenna system has been damaged by causes beyond the control of the licensee (see Sec. 73.45), or (ii) Pending completion of authorized changes in the antenna system, or (iii) If any change is made in the antenna system or any other change is made which may affect the antenna system. (See Sec. 73.45).

In the indirect method, the operating power or antenna power is found by the formula:

$$P = E_p \times I_p \times F.$$

where: E_p = plate voltage of last stage in volts, I_p = total plate current of last stage in amperes and F = efficiency factor. The efficiency factor is either given by the transmitter manufacturer or by a table in the Rules and Regulations (73.51).

For example, the operating power of a transmitter (using the indirect method), having a plate voltage of 2.8 kv, a plate current of 850 ma. and an "F" factor of .65, is:

$$2800 \text{ V} \times .85 \text{ A} \times .65 = 1547 \text{ watts or } 1.547 \text{ kw}.$$

Note that the voltage must be in volts and the current must be in amperes in order to use the formula properly.

(b) Since the direct method must be used, we used the power formula involving the antenna current (I) and the antenna resistance (R):

$$P = I^2R = (3.2)^2 \times 52 = 3.2 \times 3.2 \times 52 = 532.5 \text{ watts}.$$

(c) The operating power of an FM station is determined by using either the direct or the indirect method. Using the direct method, the power is measured by an RF transmission line meter at the output terminals of the transmitter, while operating into a dummy load of substantially zero reactance and a resistance equal to the transmission line characteristic impedance. The indirect method used for FM stations is the same as that used for AM stations.

(d) Using the indirect method formula, we can find the operating power:

$$P = E_p \times I_p \times F = 800 \times 1 \times .7 = 560 \text{ watts}.$$

Q. 11(a) What stations may be operated by a third class broadcast operator and what equipment adjustments may they perform? (b) What should be the normal operating position of a radio operator? (R & R 73.93, 73.265, 73.565)

A. Except for a very limited number of standard broadcast stations, using critical directional antenna arrays, licensees of AM and FM broadcast stations may employ third class operators for the routine station operations. However, if a station licensee elects to use third class operators, he is subject to many additional requirements. In most cases, a supervisory operator holding a Radiotelephone First-Class Operator's license must be employed either on a full-time or part-time basis.

The third class operator privileges do not include operation of television stations.

With the exceptions set forth below, adjustments of the transmitting system, inspection, maintenance, repairs, required equipment performance measurements and required field strength measurements must be performed only by a first-class radiotelephone

operator.

Except at times when the operation of the station is under the immediate supervision of an operator holding a valid radiotelephone first-class operator license, adjustments of the transmitting equipment by a third class operator shall be limited to the following:

(1) Those necessary to turn the transmitter on and off.

(2) Adjustments of external controls as may be required to compensate for voltage fluctuations in the power supply.

(3) Adjustments of external controls to maintain modulation of the transmitter within the prescribed limits.

(4) Adjustments of external controls necessary to effect routine changes in operating power which are required by the station's instrument of authorization.

(5) Adjustments of external controls necessary to effect operation in accordance with a National Defense Emergency Authorization during an Emergency Action Condition.

(6) Those necessary to change between nondirectional and directional or between differing radiation patterns, provided that such changes require only activation of switches and do not involve the manual tuning of the transmitter final amplifier or antenna phasor equipment. The switching equipment shall be so arranged that the failure of any relay in the directional antenna system to activate properly will cause the emissions of the station to terminate.

It shall be the responsibility of the licensee to insure that the person who may be required to perform these tasks, as well as to perform other duties (such as reading meters and making log entries) is properly instructed so as to be capable of performing the duties required of him at times when not under the immediate supervision of a radiotelephone first-class operator. Where necessary, printed step-by-step instructions shall be posted for those transmitter adjustments which the lesser grade operator is authorized to make. Should the transmitting apparatus be observed to be operating in any manner inconsistent with this subpart or the current instrument of authorization for the station at any time when an operator holding a valid radiotelephone first-class operator license is not immediately available, and none of the above adjustments is effective in correcting the condition of improper operation, the emissions of the station shall be immediately terminated.

(b) One or more operators holding a radio operator license or permit of a grade specified in this section, shall be in actual charge of the transmitting system, and shall be on duty either at the transmitter location or at the remote control point. If operation by remote control has not been authorized, the transmitter, required monitors and other required metering equipment, shall be readily accessible and located sufficiently close to the operator at the normal operating position that deviations from normal indications of required instruments can be observed within a 360° arc from that position. If operation by remote control is authorized, the required controls and instruments shall be readily accessible, and located sufficiently close to the operator at the normal operating position that deviations from normal indications of required metering instruments can be observed in a 360° arc from that position.

Q. 12. What are the power limitations on broadcast stations? (R & R 73.52)

A. The actual antenna input power of each station shall be maintained as near as is practicable to the authorized antenna input power and shall not be less than 90 percent nor greater than 105 percent of the authorized power; except that, if, in an emergency, it becomes technically impossible to operate with the authorized power, the station may be operated with reduced power for a period of 10 days, or less, without further authority from the Commission. If causes beyond the control of the permittee or licensee prevent restoration of authorized power within the allowed period, informal written request shall be made to the Commission in Washington, D. C., no later than the 10th day for such additional time as may be deemed necessary.

Noncommercial educational FM broadcast stations licensed to operate with transmitter output power of 10 watts or less, may be operated at less than the authorized power, but not more than 105 percent of the authorized power.

Q. 13. What logs must be kept by broadcast stations according to the Rules and Regulations of the FCC? (R & R 73.111)

A. The licensee or permittee of each standard broadcast station shall maintain program, operating and maintenance logs. The logs shall be kept in an orderly and legible manner, in suitable form, and in such detail that the data required for the particular class of station concerned is readily available. Time entries shall be either in local standard or daylight saving time and shall be indicated accordingly. Each log sheet shall be numbered and dated. No log or preprinted log or schedule which becomes a log, or portion thereof, shall be erased, obliterated, or willfully destroyed within the period of retention provided by the provision of this part. Any necessary correction shall be made only pursuant to Sections 73.112 and 73.113, and only by striking out the erroneous portion, or by making a corrective explanation on the log or attachment to it, as provided in those sections. Entries shall be made in the logs as required by Sections 73.112 and 73.113.

The operating log and the maintenance log may be kept individually on the same sheet in one common log, at the option of the permittee or licensee.

Q. 14. Who keeps the logs? (R & R 73.111)

A. Each log shall be kept by the station employee or employees (or contract operator) competent to do so, having actual knowledge of the facts required, who in the case of program and operating logs, shall sign the appropriate log when starting duty, and again when going off duty.

Q. 15. What entries are made in the program log? (R & R 73.112) In the operating log? (R & R 73.113)

A. The following entries shall be made in the program log:

(1) For each program: an entry identifying the program by name or title, an entry of the time each program begins and ends, an entry classifying each program as to type (news, religious, entertainment, sports), an entry classifying each program as to source, an entry for each program presenting a political candidate showing the name and political affiliation for such candidate.

(2) For commercial matter: an entry identifying the sponsor(s) of the program, the person(s) who paid for the announcement, or the person(s) who furnished materials or services of any kind (such as records, transcriptions, talent, scripts, etc.), an entry showing the total duration of commercial matter in each hourly time segment (beginning on the hour) or the duration of each commercial message (commercial continuity in sponsored programs, or commercial announcements) in each hour, and an entry showing that the appropriate announcements (sponsorship, furnishing material, or services, etc.) have been made. A check-mark (✓) will suffice but shall be made in such a way as to indicate the matter to which it relates.

(3) For Public service announcements: an entry showing that a public service announcement has been broadcast, together with the name of the organization or interest on whose behalf it has been made.

(4) For other announcements: an entry of the time that each station identification is made (call letters and licensed location), an entry for each announcement presenting a political candidate showing the name and political affiliation of such candidate, an entry showing that a mechanical reproduction announcement has been made. The licensee, whether employing manual or automatic logging, or a combination thereof, must be accurately able to furnish the Commission with all information required to be logged.

Manually kept log. Where, in any program log, or preprinted program log, or program schedule which upon completion is used as a program log, a correction is made before the person keeping the log has signed the log upon going off duty, such correction, no matter by whom made, shall be initialed by the person keeping the log prior to his signing of the log when going off duty, as attesting to the fact that the log, as corrected, is an accurate representation of what was broadcast. If corrections or additions are made on the log after it has been so signed, explanation must be made on the log or on an attachment to it, dated and signed by either the person who kept the log, the station program director or manager, or an officer of the licensee.

An FM station, operating under a Subsidiary Communications Authorization (SCA), should include in the log, at least once a day, a general description of the program content. Any changes in the program content and times of changes, should also be logged.

The following entries shall be made in the operating log by the properly licensed operator in actual charge of the transmitting apparatus, or by automatic devices. (See (b) below.)

(1) An entry of the time the station begins to supply power to the antenna and the time it stops. (2) See Answer 26.

(3) An entry at the beginning of operation in each mode and at intervals not exceeding three hours, of the following (actual readings observed prior to making any adjustments to the equipment) and, when appropriate, an indication of corrections made to restore parameters to normal operating values: (i) Operating constants of last radio stage (total plate voltage and plate current). (ii) Antenna current or common point current (if directional) without modulation.

(4) An entry each day of the following where applicable: (i) Antenna base current(s) without modulation for each mode of operation: (a) Where remote antenna meters or a remote common point meter are normally employed but are defective. (b) Where required by the station license for directional antenna operation. (ii) Where there is remote control operation of a directional antenna station, readings for each pattern taken at the transmitter (within two hours of commencement or operation with each pattern) of: (a) Common point current without modulation. (b) Base current(s) without modulation. (c) Phase monitor sample loop current(s) without modulation. (d) Phase indications.

(5) Any other entries required by the instrument of authorization or the provisions of this part.

(6) The entries required by Section 17.49 and (c) of this chapter. (b) Automatic devices accurately calibrated and with appropriate time, date and circuit functions may be utilized to record the entries in the operating log: Provided, That: (1) They do not affect the operation of circuits or accuracy of indicating instruments of the equipment being recorded; (2) The recording devices have an accuracy equivalent to the accuracy of the indicating instruments; (3) The calibration is checked against the original indicators at least once a week and the results noted in the maintenance log; (4) Provision is made to actuate automatically an aural alarm circuit located near the operator on duty, if any of the automatic log readings are not within the tolerances or other requirements specified in the rules or instrument of authorization; (5) Devices which record each parameter in sequence must read each parameter at least once during each 10-minute period and clearly indicate the parameter being recorded; (6) The automatic logging equipment is located at the remote control point if the transmitter

is remotely controlled, or at the transmitter location if the transmitter is manually controlled; (7) The automatic logging equipment is located in the near vicinity of the operator on duty and is inspected by him periodically during the broadcast day; and (8) The indicating equipment conforms with the requirements of Sec. 73.39 except that the scales need not exceed 2 inches in length and arbitrary scales may not be used.

Manually kept log. Any necessary corrections in a manually kept operating log shall be made only by the person making the original entry who shall make and initial each correction prior to signing the log when going off duty, in accordance with 73.111(a). If corrections or additions are made on the log after it has been so signed, explanation must be made on the log or on an attachment to it, dated and signed by either the operator who kept the log, the station technical supervisor or an officer of the licensee.

FM stations, using the direct method of determining power, log the RF transmission line meter reading rather than the antenna current, as in AM stations.

An FM station operating under a Subsidiary Communications Authorization must keep a log of its operation. The log may be included as part of the operating log for the main channel or may be kept separately. Entries are required of the time the subcarrier generator is turned on and when it is turned off (excluding subcarrier interruptions of 5 minutes or less). An entry is also required for the time modulation is applied to the subcarrier and the time the modulation is removed from the subcarrier.

FM broadcast stations with an operating power of 10 watts or less are only required to log the time the station begins to supply power to the antenna, the time it stops, and entries concerning the daily observations of tower lights.

Q. 16. When may abbreviations be used in the station's logs? (R & R 73.111)

A. Key letters or abbreviations may be used if proper meaning or explanation is contained elsewhere in the log.

Q. 17. How may a station's logs be corrected?(R & R 73.111).

A. Any necessary correction to a station's logs may be made by striking out the erroneous portion, initialing the correction made, and indicating the date of correction. Also, see Answer 15 above.

Q. 18. According to the Rules and Regulations of the FCC, how long must station logs be retained? (R & R 73.115)

A. Logs of standard broadcast stations shall be retained by the licensee or permittee for a period of two years: Provided, however, That logs involving communications incident to a disaster or which include communications incident to or involved in an investigation by the Commission and concerning which the licensee or permittee has been notified, shall be retained by the licensee or permittee until he is specifically authorized in writing by the Commission to destroy them: Provided, further, That logs incident to or involved in any claim or complaint of which the licensee or permittee has notice, shall be retained by the licensee or permittee until such claim or complaint has been fully satisfied, or until the same has been barred by statute limiting the time for the filing of suits upon such claims.

Q. 19. What information must be given to an FCC inspector at any reasonable hour? (R & R 73.116)

A. The following shall be made available upon request by an authorized representative of the FCC: (a) Program, operating and maintenance logs. (b) Equipment performance measurements required by Sec. 73.47. (c) Copy of most recent antenna resistance or common-point impedance measurements submitted to the Commission. (d) Copy of most recent field intensity measurements to establish performance of directional antennas required by Sec. 73.151.

The above information must be made available for inspection by representatives of the FCC at any reasonable hour.

Q. 20. What must be included in a station identification and how often is it given? (R & R 73.1201)

A. Station identification shall consist of the station's call letters, immediately followed by the name of the community or communities, specified in its license as the station's location.

These identification announcements must be made: (1) At the beginning (sign-on) and ending (sign-off) of each time of operation, and (2) hourly, as close to the hour as feasible, at a natural break in program offerings. Television broadcast stations may make these announcements visually or aurally. The only legal requirement for "sign-on" or "sign-off" is the correct station identification.

Q. 21. What should an operator do if the modulation monitor becomes defective? (R & R 73.56)

A. (a) Each station shall have in operation, either at the transmitter or at the place the transmitter is controlled, a modulation monitor of a type approved by the Commission. (b) In the event that the modulation monitor becomes defective, the station may be operated without the monitor, pending its repair or replacement, for a period not in excess of 60 days without further authority of the Commission: Provided, That: (1) Appropriate entries shall be made in the maintenance log of the station showing the date and time the monitor was removed from and restored to service. (3) The degree of modulation of the station shall be monitored with a cathode ray oscilloscope or other acceptable means.

Q. 22. When should minor corrections to the transmitter be made? Before or after logging the meter readings? (R & R 73.113)

A. Minor corrections to the transmitter should be made after

logging the meter readings.

Q. 23. What must a broadcast station do when it transmits matter for which it receives compensation? (R & R 73.119 and 73.289)

A. When a broadcast station transmits matter for which it receives or expects to receive any compensation such as money, services, or other consideration, the station must announce that the matter is sponsored or furnished and also announce the name of the sponsor. However, when a commercial product or service is advertised, use of the sponsor's corporate name, trade name, or name of the product or service will suffice if it is clear that the product name identifies the sponsor. Broadcast station licensees are responsible to insure that their employees or others connected with program material are fully aware that accurate sponsor identification must be obtained and broadcast. Sponsored programs and announcements that do not promote a specific commercial service or product must also be identified by the name of the actual sponsor. Operators keeping program logs must be alert to insure that sponsored matter is announced at the time of the broadcast and the sponsor is correctly identified in the program log.

Q. 24. When should an operator announce a program as "recorded? (R & R 73.1208)

A. Any taped, filmed or recorded program material in which time is of special significance, or by which an affirmative attempt is made to create the impression that it is occurring simultaneously with the broadcast, shall be announced at the beginning as taped, filmed or recorded. The language of the announcement shall be clear and in terms commonly understood by the public. For television stations, the announcement may be made visually or aurally.

Taped, filmed or recorded announcements which are of a commercial, promotional or public service nature, need not be identified as taped, filmed or recorded.

Q. 25. How often should the tower lights be checked for proper operation? (R & R 17.47 and 17.98)

A. Once each day, the operator is required to check for the proper operation of the tower lighting system. Most tower lighting systems are turned on and off with an automatic actuation switch controlled by a photocell. Stations using the photocell are required to burn the lights continuously if the automatic actuation switch does not operate properly. Any observed or otherwise known outage or improper functioning of a code or rotating beacon light or top light not corrected in 30 minutes should be reported by telephone or telegraph to the nearest Flight Service Station or office of the Federal Aviation Administration. Notice should also be given to the Flight Service Station or FAA office when the situation has been corrected.

Q. 26. What record is kept of tower light operation? (R & R 17.49)

A. The licensee of any radio station which has an antenna structure requiring illumination, shall make the following entries in the station record of the inspections:

(a) The time the tower lights are turned on and off each day, if manually controlled;

(b) The time the daily check of proper operation of the tower lights was made, if automatic alarm system is not provided;

(c) In the event of any observed or otherwise known failure of a tower light: (1) Nature of such failure. (2) Date and time the failure was observed, or otherwise noted. (3) Date, time and nature of the adjustments, repairs or replacements made. (4) Identification of Flight Service Station (Federal Aviation Agency) notified of the failure of any code or rotating beacon light or top light not corrected within 30 minutes, and the date and time such notice was given. (5) Date and time notice was given to the Flight Service Station (Federal Aviation Agency) that the required illumination was resumed.

(d) Upon completion of the periodic inspection required at least once each three months: (1) The date of the inspection and the condition of all tower lights and associated tower lighting control devices, indicators and alarm systems. (2) Any adjustments, replacements or repairs made to insure compliance with the lighting requirements, and the date such adjustments, replacements or repairs were made.

Q. 27. What is an Emergency Action Notification? (EAN) (R & R 73.907)

A. The Emergency Action Notification is the notice (with or without an Attack Warning) to all licensees and regulated services of the Federal Communications Commission and to the general public, of the existence of an Emergency Action Condition. The Emergency Action Notification is released upon direction of the President of the United States, and is disseminated only via the Emergency Action Notification System.

Q. 28. What is an Emergency Action Condition? (R & R 73.908)

A. An Emergency Action Condition is the condition which exists after the transmission of an Emergency Action Notification and before the transmission of the Emergency Action Termination. It is actually a national, state or local area emergency situation posing a threat to the safety of life or property.

Q. 29. What equipment must be installed in broadcast stations in regard to reception of an Emergency Action Notification? (R & R 73.933)

A. (a) All broadcast station licensees must install and oper-

ate, during their hours of broadcast operation, equipment capable of receiving Emergency Action Notifications or Terminations transmitted by other radio broadcast stations. This equipment must be maintained in operative condition, including arrangements for human listening watch or automatic alarm devices, and shall have its termination at each transmitter control point. However, where more than one broadcast transmitter is controlled from a common point by the same operator, only one set of equipment is required at that point.

(b) The off-the-air monitoring assignment of each standard, FM and television broadcast station is specified in the Detailed State Emergency Broadcast System (EBS) Operational Plan. Particular attention should be paid to avoiding "closed loops" in monitoring assignments.

(c) Prior to commencing routine operation or originating any emissions under program test, equipment test, experimental, or other authorizations or for any other purpose, licensees or permittees shall first ascertain whether an Emergency Action Condition exists and, if so, shall operate only in accordance with the Basic Emergency Broadcast System (EBS) Plan and Detailed State Emergency Broadcast System (EBS) Operational Plan.

Q. 30. How often should EBS test transmissions be sent? During what time period are they sent? (R & R 73.910, 73.961)

A. EBS test transmissions of the Emergency Action Notification System will be conducted by standard, FM and television broadcast stations once each week on an unscheduled basis, between the hours of 8:30 A.M. and local sunset. These tests will be conducted in accordance with procedures set forth in the EBS check list furnished to all broadcast stations.

Q. 31. During a period of an Emergency Action Condition, what should all non-participating stations do? (R & R 73.932(a))

A. Non-participating stations must observe radio silence.

Q. 32. (a) What is meant by the term "rebroadcast"? (b) What is the rule regarding the rebroadcasting of a program of another broadcasting station? (R & R 73.1207)

A. (a) The term "rebroadcast" means reception by radio of the programs of a radio station, and the simultaneous or subsequent retransmission of such programs by a broadcast station.

(b) No broadcasting station shall rebroadcast the program, or any part thereof, of another broadcasting station without the express authority of the originating station. A copy of the written consent, of the licensee originating the program shall be kept by the licensee of the station rebroadcasting such program, and shall be made available to the Commission upon request.

Q. 33. What are the rules with regard to broadcasting lottery information? (R & R 73.1211)

A. Broadcast stations are prohibited from transmitting announcements or programs promoting or containing information that would promote lotteries. A lottery is any scheme in which money or a prize of value is awarded to a person selected by lot or chance, if a condition of winning is that a person must have furnished any money, purchased a product or service, or have in his possession a product sold by the sponsor of a program broadcast on the station in question.

The provisions stated above do not apply to a lottery conducted by a State acting under authority of State law when such information is broadcast: (1) by a radio or television broadcast station licensed to a location in that State, or (2) by a radio or television broadcast station licensed to a location in an adjacent State which also conducts such a lottery. Such State "lottery" means the pooling of proceeds derived from the sale of tickets or chances and allotting those proceeds or parts thereof by chance to one or more chance takers or ticket purchasers. It does not include the placing or accepting of bets or wagers on sporting events or contests.

Q. 34. If a license or permit is lost, what action must be taken by the operator? What is the usual license term for radio operators? When may a license be renewed? (R & R 13.4, 13.11, 13.71 and 13.72)

A. See answers to Questions 4, 5 and 7 of Element 1, Series "O" and "M".

Q. 35. Where does an operator post his permit? (R& R 73.92, 73.264 and 73.564)

A. The operator must post his permit or posting statement at the place where he is on duty at the transmitter control point. FCC Form 759 is a posting statement used by operators employed at more than one station. The permit is posted at one station and FCC Forms 759 are posted at other stations where the operator is employed. The station license and other operating authorizations must be posted at the transmitter control point with all terms visible.

Q. 36. What is the rule regarding the broadcasting of a telephone conversation? (R & R 73.1206)

A. Before broadcasting a telephone conversation or recording a telephone conversation for later broadcast, the parties to the conversation must be informed of the intention to broadcast the conversation. However, station employees who may be presumed to be aware that their telephone conversations are intended for broadcast are not required to be advised of the broadcasting of their calls. Also, no notice of broadcast is required for per-

sons originating calls to programs which normally broadcast telephone conversations coming into the program.

Q. 37. What is a Subsidiary Communications Authorization? For what purpose is it used? (R & R 73.293, 73.295, 73.297, 73.593, 73.595 and 73.596)

A. A Subsidiary Communications Authorization (SCA) is a permit to use a subchannel within the main FM channel assignment.

In addition to monaural operation, FM stations may elect to broadcast stereo programming. This is accomplished by inserting a subchannel within the FM channel. In addition to the stereophonic subchannel, an entirely different subchannel may also be used. Programs transmitted by way of the Subsidiary Communications Authorization cannot be received without a special multiplex receiver. Most SCA subcarriers are used for the transmission of subscription background music, such as the music that is broadcast to stores and factories by Muzak. Other SCA uses are for detailed weather forecasting, special time signals, and other material of a broadcast nature expressly designed and intended for business, professional, educational, religious, trade, labor, agriculture or other groups engaged in any lawful activity.

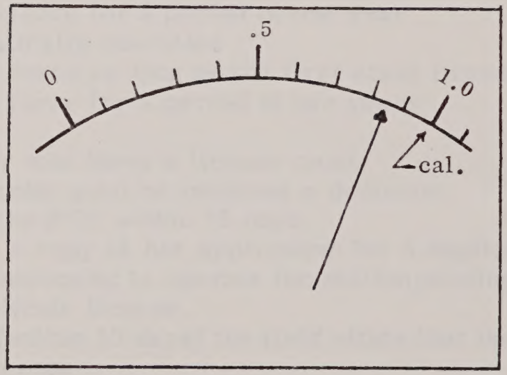
Q. 38(a) What is the basic difference between directional antenna systems and non-directional antenna systems? (b) How does the radio operator determine that a directional antenna is radiating according to a specified pattern? (c) Discuss phase differences and current ratios with respect to directional antenna systems. (R & R 73.69, 73.95)

A. (a) Non-directional AM stations use a single antenna tower and transmit the radio signal with equal strength in all directions from the station. Directional AM stations utilize more than one antenna tower. By establishing the position of each tower, the power radiated by each tower, and the phase of the signal in each tower, different signal strengths can be radiated in various directions. Directional antenna systems are used to improve the signal over desired areas and to reduce the signal in the direction of other stations to prevent interference.

(b) To determine if a directional antenna system is radiating the signal according to a specified radiation pattern, an instrument called an antenna monitor is installed at the station. The antenna monitor enables the operator to determine if the radio frequency (RF) current in each tower is of the correct value and if the phase of the signal radiated by each tower is also correct. Some antenna monitors indicate the ratio of current in each tower to the current in one tower called the reference tower.

(c) A radio frequency signal or current is actually an alternating current. In addition to reversing itself continuously, its actual instantaneous value is varying from zero to a certain amount. If the instantaneous peak values of the signals arrive at each tower at the exact same time, we say that the currents in each tower are "in phase" with each other. If the instantaneous peak values of the signals do NOT arrive at the towers at the exact same time, we say that the currents are "out of phase" with each other. The difference in time or phase is measured in degrees.

In most directional antenna systems, the currents in the various towers are out of phase with each other. The actual antenna currents (as read by ammeters), also tend to be different from each other. For each directional antenna tower, the station license contains a list of the required signal phases and antenna base current ratios. The antenna base current ratio for a tower is calculated by dividing the current meter reading for that tower by the current meter reading for the designated reference tower. The ratio, either calculated or read on the antenna monitor (see figure below), must not deviate more than 5 percent from the value on the station license. Operators on duty at AM stations, using directional antenna systems, should know how to read the antenna monitor meters, and should know how to use charts, tables or other instructions to determine if the station is operating correctly, if attention by the station's first class operator is required, or if the station must terminate operation.



Basic Antenna Current Ratio Meter.

The meter is set for "1.0" (cal.) by reading the current in the designated reference tower. The current is then taken for a given tower and its current ratio is then read on the meter. The meter can be in percentage or ratio. The above meter reads a ratio of .85.

FCC-TYPE EXAMINATION
ELEMENT 1

1. A response to a Notice of Violation must be made within:
   a. 10 days c. 3 days
   b. 24 hours d. 30 days

2. After receipt of a Notification of Suspension, the suspension order becomes effective within:
   a. 24 hours c. 3 days
   b. 30 days d. 15 days

3. The urgency signal is second in priority to:
   a. Communications relative to direction-finding bearings
   b. Communications preceded by a safety signal
   c. Distress calls, distress messages, and distress traffic
   d. Important international commerce bulletins

4. Corrections in the radio log may be made by:
   a. An operator licensed by the FCC
   b. The person who made the initial entry
   c. A notary public
   d. A person familiar with the operation of the installation

5. Radio stations are subject to inspection by:
   a. Any federal agency
   b. The Federal Bureau of Investigation
   c. The Federal Communications Commission
   d. The Federal Radio and Wire Authority

6. An application for renewal of a radio operator's license may be made:
   a. 15 months before expiration of the current license
   b. Within a year of expiration of the current license
   c. At all times, if there have been no violations
   d. Within 15 days of issuance of the original license

7. The secrecy provisions of the law do not apply to:
   a. Commercial bulletins
   b. Danish bulletins
   c. Holders of 1st Class Radiotelephone Operator's Licenses
   d. Distress messages

8. A response to a Notice of Violation must be addressed to:
   a. Any office of the Federal Communications Commission
   b. Any police authority of the continental United States
   c. The office of the FCC that originated the official notice
   d. The nearest Federal District Court

9. A person who has received an order of suspension may:
   a. Disregard the violation if he feels it to be unjust
   b. Request a hearing
   c. Order a court injunction on the FCC office
   d. Operate with an input power of less than 1 kilowatt

10. False signals of distress are:
   a. Allowed only if very low power is used
   b. Prohibited by law
   c. Common practical jokes among experienced operators
   d. Good tests of rescue facilities

11. Applicants for FCC licenses must generally be:
   a. Citizens of the United States only
   b. Citizens of the United States and Canada only
   c. Citizens of any country, provided they have held a radio operator's license of their respective country
   d. Citizens of English speaking countries

12. The usual license term for a radio operator is:
   a. one year c. three years
   b. two years d. five years

13. The second class radiotelephone license of a radio operator who qualifies for a first class license is:
   a. Kept in force for a period of one year
   b. Automatically cancelled
   c. Kept in force as long as the first class license is valid
   d. Kept in force for a period of two years

14. An operator who loses a license must:
   a. Not operate until he receives a duplicate
   b. Notify the FCC within 15 days
   c. Exhibit a copy of his application for a duplicate license while continuing to operate the station pending receipt of the duplicate license.
   d. Notify (within 10 days) the field office that issued the original license

15. Which of the following need not be done in correcting an error in a log:
   a. Indicate date of correction
   b. Indicate time of correction
   c. Initial the correction
   d. Strike out erroneous portion

16. Unidentified or superfluous radio communications may:
   a. Be transmitted on frequencies above 30 MHz.

- b. Not be transmitted at all
- c. Be transmitted on frequencies that are not used for distress, urgent or safety signals.
- d. None of the above

17. A person who willfully violates a provision of the Communications Act of 1934 faces a penalty of:
    - a. Not more than $500 fine
    - b. Not more than $10, 000 fine
    - c. Not more than $10, 000 fine and imprisonment for a term not exceeding one year
    - d. Not more than $5, 000 fine and imprisonment for a term not exceeding two years

18. Any person who knowingly violates a rule made by the Federal Communications Commission, shall, in addition to other penalties provided by law, receive a fine of not more than:
    - a. $500 for each day during which the offense occurs
    - b. $1000 for each day during which the offense occurs
    - c. $50 for each day during which the offense occurs
    - d. None of the above

19. A licensee who receives a notice that he has violated an FCC rule, must:
    - a. Send a written answer to the FCC in Washington, D. C. within 10 days.
    - b. Send a written answer to the FCC in Washington, D. C. within 15 days
    - c. Send a written answer to the FCC office originating the notice within 10 days.
    - d. Send a written answer to the FCC office originating the notice within 15 days.

20. The FCC may not suspend an operator license upon proof that the licensee:
    - a. Has failed to carry out a lawful order of the master of the ship on which he is employed.
    - b. Has transmitted superfluous radio communications
    - c. Has assisted another to obtain an operator's license by fraudulent means
    - d. None of the above

FCC-TYPE EXAMINATION

ELEMENT 2—SERIES "O"

1. The word "OVER" indicates:
    - a. The conclusion of a series of transmissions
    - b. The station is leaving the air temporarily
    - c. The transmission is over and no response is expected
    - d. The transmission is over and a reply is expected

2. The system of substituting words for corresponding letters is known as:
    - a. The Dewey system
    - b. The substitute transmission method
    - c. The phonetic system
    - d. The safety-sending method

3. The word "OUT" means:
    - a. The station is being interfered with
    - b. The station is leaving the air
    - c. The transmission is ended and a response is expected
    - d. The transmission is concluded and no response is expected

4. Shouting into a microphone may cause:
    - a. Deattenuation
    - b. Amplification
    - c. Rectification
    - d. Overmodulation

5. When speaking into a microphone in a noisy location, it is good practice to:
    - a. Shield the microphone with the hands
    - b. Shout directly into the microphone
    - c. Turn down the audio gain control
    - d. Speak very softly

6. Unnecessary calling should be avoided since it may cause:
    - a. Overmodulation
    - b. Interference with other stations
    - c. Electro-magnetic decoupling
    - d. Antenna wear

7. In radiotelephony, the words "READ BACK" mean:
    - a. I am repeating my previous transmission
    - b. This transmission is being read
    - c. Repeat the entire message back to me exactly as you have received it
    - d. This is a "copied" transmission, not an original reading.

8. A separation between portions of a single transmission should be indicated by inserting the word:
   a. SEPARATE   c. BREAK
   b. STOP   d. SECURITY

9. The licensed operator of a ship's radiotelephone station exhibits his authority to operate by:
   a. Wearing a lapel pin with his registration number
   b. Printing circulars with his qualifications stated plainly
   c. Demonstrating proficiency in reception of American Morse Code
   d. Posting his license conspicuously at the principal location of the station

10. All calling should be:
   a. Lengthy and detailed
   b. Done on working frequencies
   c. Clear and concise
   d. Repeated several times

11. When voice transmissions are not being made, the transmitter should be:
   a. Dismantled
   b. Moved away from windows, air vents, etc.
   c. Kept on the air
   d. Kept off the air

12. If an operator is told that his voice is distorting, he should:
   a. Speak more softly or back away from the microphone
   b. Report the insult to the FCC
   c. Dismantle the modulator immediately
   d. Use A1 emission promptly

13. An operator will find specifications for obstruction marking and lighting for antenna towers in:
   a. The Communications Act of 1934
   b. Part 17 of the FCC Rules and Regulations
   c. The Geneva Radio Regulations of 1934
   d. The bulletins issued by the nearest FCC office

14. In the event of an emergency, an operator may:
   a. Increase his power in excess of the amount specified in the instrument of authorization
   b. Utilize his station in a manner other than that specified in the instrument of authorization
   c. Not utilize his station at all
   d. Transmit on frequencies other than those specified in the instrument of authorization

15. When a person other than the licensed operator speaks into a microphone, responsibility for proper operation of the station is borne by:
   a. The owner of the station
   b. The licensed operator in charge of the station
   c. The person himself, provided he is over 21 years of age
   d. The person himself, provided he is over 18 years of age

16. In radiotelephone communications, a common expression "Repeat" means:
   a. Speak slower   c. Repeat twice
   b. Say again   d. Use the phonetic alphabet

17. An operator who leaves his station unattended in a public place:
   a. Is not responsible for the transmitter when he is not present
   b. Must make it inaccessible to unauthorized persons
   c. Must always leave another licensed operator with the transmitter during daytime hours
   d. Must turn the transmitter off

18. An operator who hears profanity being used at his station need not:
   a. End the transmission
   b. Enter relevant details into the log
   c. Repeat the incident to the FCC
   d. Personally order a citizens arrest of the person uttering the profanity.

19. The word "Clear" when used in radiotelephone indicates that:
   a. The transmission is completed and no response is expected
   b. The immediately preceding message has been received and is completely understood
   c. The transmission is completed and a response is expected
   d. The next message has nothing to do with the previous message.

20. In testing a radiotelephone transmitter, an operator should not:
   a. Clearly indicate that he is testing
   b. Give the station call sign
   c. Interfere with other communications
   d. Test for as short a time as possible

FCC-TYPE EXAMINATION
ELEMENT 9

1. The percentage of modulation on negative peaks of frequent recurrence in an FM transmitter must not be more than:
   a. 50% c. 85%
   b. 75% d. 100%

2. 18 milliamperes is equal to:
   a. 18000 amperes c. 1.8 amperes
   b. .018 amperes d. .18 amperes

3. Using the indirect method, what is the operating power of a transmitter with an efficiency factor of 0.65, whose last RF stage has a plate voltage of 850 volts and a plate current of 60 ma.
   a. 33 watts c. 51 watts
   b. 33,150 watts d. 51,000 watts

4. Abbreviations may be used in a log:
   a. Only if the operator holds a first class radiotelephone license
   b. Only if they are approved FCC-type abbreviations
   c. If proper meaning or explanation is given elsewhere in the log
   d. Abbreviations may not be used in a log.

5. Corrections in a manually kept operating log may be made:
   a. only by the person making the original entry
   b. By persons competent to do so, having actual knowledge of the facts
   c. Only by the person in charge of the station
   d. Corrections may not be made in a log

6. Station logs must be retained for a period of:
   a. 1 year c. 3 years
   b. 2 years d. 5 years

7. Logs pertaining to communications involving a disaster must be retained for a period of:
   a. 2 years c. 5 years
   b. 3 years d. until authorized by the FCC to destroy them

8. The following must be included in a station identification:
   a. Call letters and location.
   b. Call letters.

c. Call letters, location and time.
d. Call letters and time.

9. In general, station identification must be made:
a. At the beginning and end of each time of operation.
b. Every 15 minutes.
c. Every 30 minutes.
d. At the beginning and end of each time of operation and hourly, as close to the hour as feasible during a natural break in the program.

10. The Standard Broadcast Band refers to the band of frequencies from:
a. 500 kHz to 1600 kHz.
b. 535 kHz to 1605 kHz.
c. 88 MHz to 108 MHz.
d. 550 kHz to 1700 kHz.

11. An operator must announce that a recorded program is in fact recorded:
a. If the program lasts at least one half minute.
b. Even if it is obvious to all that the program is recorded.
c. If an attempt is made to create the impression that it is occurring simultaneously with the broadcast.
d. An announcer need not indicate the fact that a particular program is recorded.

12. E B S stands for:
a. Emergency Broadcast System.
b. Energy Broadband System.
c. Electronic Broadcast Service.
d. None of the above.

13. E B S test transmissions should be sent at least:
a. Once a week.
b. Once a month.
c. Once each day.
d. Twice a week.

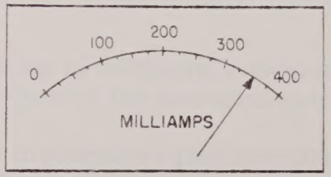
14. During a period of an Emergency Action Condition, non-participating stations:
a. Must continue their usual activity.
b. Must observe radio silence.
c. Must monitor specific stations.
d. Must keep their carriers on but stop modulation.

15. Tower lights shall be checked:
a. At least once each week.
b. At the beginning and end of each days activities.
c. At exactly one hour after sunset.
d. At least once each day.

16. If the tower lights fail, the operator must immediately notify the nearest:
a. Federal Aviation Agency office
b. Civil Air Patrol office
c. FCC office
d. E B S station

17. Which of the following exceeds the power limitations for a 25 kw. broadcast station?
a. 25.900 kw.
b. 23 kw.
c. 22,600 watts
d. 26,300 watts

18. The meter reads:
a. 350 amperes
b. 3.5 milliamperes
c. .35 amperes
d. 35 amperes



19. In making a log correction, the erroneous portion must be struck out, the corrections made, and:
a. the correction must be initialed.
b. the correction must be initialed and the date of correction must be entered.
c. the bottom of each page where corrections are made must be signed by the operator making the corrections.
d. slight corrections need not be initialed.

20. In the event of a malfunction of a part of the remote control equipment, the licensee:
a. must notify the nearest FCC office.
b. may operate for a period of 24 hours while repairs are being made.
c. must cease operation by remote control.
d. none of the above.

21. Using the direct method, what is the power of a broadcast station whose antenna resistance is 55 ohms, plate voltage of final stage is 2,000 volts, plate current of final stage is 800 ma., antenna current is 5 A.?
a. 10,000 W. b. 1280 W. c. 1600 W. d. 1375 W.

22. If the antenna base current ratio of an antenna tower (tower 1) is .4 and the base current of the reference tower (tower 2) is 5 amperes, what is the antenna base current in tower 1?
a. 0.8 A. b. 2 A. c. 1.25 A. d. 12.5 A.

23. Operator licenses may not be renewed:
a. during the final year of the license term.
b. within a year after the expiration of the license.
c. during the last two years of the license term.
d. none of the above.

24. A three -tower antenna system would be used at a:
a. non-directional station c. omnidirectional station
b. directional station d. tri-directional station

25. A "peak flasher" is used to indicate:
a. modulation peaks c. large frequency errors
b. current peaks d. excessive power

26. 850 volts is the same as:
a. 8, 500 kilovolts c. 850, 000 kilovolts
b. 0.85 kilovolts d. 8.5 kilovolts

27. What must an operator do if he notices an improper reading due to a malfunction of the remote control equipment?
a. he must cease operating.
b. he must switch his mode of operation.
c. he must reduce his power until the malfunction is corrected.
d. he must cease operating by remote control.

28. Where must an operator post his operator permit if he is employed at more than one station?
a. at his principal place of employment.
b. he need only post his permit at a station where he is the chief operator.
c. he must post his permit or special form at all stations where he is employed.
d. his permit must be kept in his possession at all times.

29. Programs transmitted by way of the Subsidiary Communications Authorization:
a. must be received with a special multiplex receiver.
b. are used only for the transmission of music.
c. make use of a subchannel inserted 25 kHz outside the main FM channel assignment.
d. must use monaural operation.

30. A broadcast station may transmit announcements promoting lotteries, provided:
a. the sponsor is not a profit-making organization.
b. the sponsor is a religious or fraternal organization.
c. the selection of the lottery winner is carefully supervised.
d. a broadcast station may not transmit announcements promoting lotteries.

31. When a commercial product is advertised, how must the sponsor be identified?
a. by his corporate name. b. by his trade name.
c. by the product name.
d. by any of the above, provided it is clear who the sponsor is.

32. An 8 watt FM broadcast station is required to log:
a. the plate voltage and current of the final stage.
b. the daily observations of the tower lights.
c. the antenna base current.
d. RF transmission line base reading.

33. If an operator's license is lost:
a. he must cease operating until his new license is received.
b. he must apply for a new license on FCC Form 736.
c. a copy of his duplicate license application must be posted.
d. he may continue to operate until his original license would have expired.

34. With regard to the broadcasting of telephone conversations:
a. all parties must be informed of the intention to broadcast their calls.
b. persons originating calls to programs that normally broadcast telephone conversations need not be notified.
c. only station employees need not be notified.
d. no one need be notified if the station is broadcasting to the general public.

35. Directional antenna systems do not generally:
a. reduce interference. b. use several towers.
c. have the currents in each tower in phase with each other.
d. increase the signal strength in the desired area.

36. What is the antenna base current ratio of an antenna tower if its base current is 7 amperes and the antenna base current in the reference tower is 4 amperes?
a. .57 b. 28 c. 1.75 d. 2.8

37. Using the indirect method, what is the operating power of a broadcast station if the plate voltage of the last stage is 1500 volts, plate current is 700 ma., and efficiency factor is .7?
a. 1050 watts b. 735 watts c. 105 watts d. 7350 watts

38. 3.75 kilowatts are equal to:
a. 375 watts c. 0.0375 watts
b. 37.5 watts d. 3, 750 watts

39. A third class operator with a broadcast endorsement may make repairs to:
a. prevent voltage fluctuations in the primary power supply.
b. correct directional antenna malfunction.
c. the antenna phasor equipment. d. none of the above

40. If the operation of a transmitter is by remote control, what percentage of the remote controls and instruments must be readily accessible?
a. 50% b. 100% c. 75%
d. 100% of those dealing with power and frequency.

ANSWERS TO
FCC-TYPE EXAMINATIONS

ELEMENT 1

1. a
2. d
3. c
4. b
5. c
6. b
7. d
8. c
9. b
10. b
11. a
12. d
13. b
14. c
15. b
16. b
17. c
18. a
19. c
20. d

ELEMENT 2—SERIES "O"

1. d
2. c
3. d
4. d
5. a
6. b
7. c
8. c
9. d
10. c
11. d
12. a
13. b
14. b
15. b
16. b
17. b
18. d
19. a
20. c

ELEMENT 2—SERIES "M"

1. d
2. d
3. b
4. b
5. a
6. b
7. a
8. b
9. a
10. d
11. b
12. c
13. c
14. c
15. c
16. d
17. d
18. b
19. b
20. a

ELEMENT 9

1. d
2. b
3. a
4. c
5. a
6. b
7. d
8. a
9. d
10. b
11. c
12. a
13. a
14. b
15. d
16. a
17. d
18. c
19. b
20. c
21. d
22. b
23. c
24. b
25. a
26. b
27. d
28. c
29. a
30. d
31. d
32. b
33. c
34. b
35. c
36. c
37. b
38. d
39. d
40. b

Q. 13. May an operator deliberately interfere with any radio communication or signal? (R & R 13.69)

A. 13. No.

Q. 14. What type of communication has top priority in the mobile service? (ART.)

A. 14. Distress calls, distress messages and distress traffic have top priority in the mobile service. Urgent signals are next in the order of priority, followed by safety signals.

Q. 15. What are the grounds for suspension of operator licenses? (Sec. 303(m)(1))

A. 15. The FCC may suspend an operator license upon proof sufficient to satisfy the Commission that the licensee:

(a) Has violated any provision of any Act, treaty or convention binding on the United States, which the Commission is authorized to administer, or any regulation made by the Commission under any such Act, treaty, or convention; or

(b) Has failed to carry out a lawful order of the master or person lawfully in charge of the ship or aircraft on which he is employed; or

(c) Has willfully damaged or permitted radio apparatus or installations to be damaged; or

(d) Has transmitted superfluous radio communications or signals or communications containing profane or obscene words, language, or meaning, or has knowingly transmitted ---

(1) False or deceptive signals or communications, or

(2) A call signal or letter which has not been assigned by proper authority to the station he is operating; or

(e) Has willfully or maliciously interfered with any other radio communications or signals; or

(f) Has obtained or attempted to obtain, or has assisted another to obtain or attempt to obtain, an operator's license by fraudulent means.

Q. 16. When may an operator divulge the contents of an intercepted message? (Sec. 605)

A. 16. An operator may divulge the contents of an intercepted message if the message is for the use of the general public or relating to ships in distress.

Q. 17. If a licensee is notified that he has violated an FCC rule or provision of the Communications Act of 1934, what must he do? (R & R 1.76)

A. 17. Within 10 days from receipt of notice, or such other period as may be specified, the licensee shall send a written answer, in duplicate, direct to the office of the Commission originating the official notice. If an answer cannot be sent or acknowledgment made within such 10-day period by reason of illness or other unavoidable circumstances, acknowledgment and answer shall be made at the earliest practicable date with a satisfactory explanation of the delay. The answer to each notice shall be complete in itself and shall not be abbreviated by reference to other communications or answers to other notices. In every instance, the answer shall contain a statement of action taken to correct the condition or omission complained of and to preclude its recurrence. In addition: (1) If the notice relates to violations that may be due to the physical or electrical characteristics of transmitting apparatus and any new apparatus is to be installed, the answer shall state the date such apparatus was ordered, the name of the manufacturer, and the promised date of delivery.

Q. 18. If a licensee receives a notice of suspension of his license, what must he do? (R & R 1.72)

A. 18. If a licensee receives a notice of suspension of his license, he must make a written application to the Commission within 15 days of receipt of the notice for a hearing on the suspension order.

Q. 19. What are the penalties provided for violating a provision of the Communications Act of 1934 or a Rule of the FCC? (Sec. 501, 502)

A. 19. Any person who willfully and knowingly violates the Communications Act of 1934 shall, upon conviction thereof, be punished for such offense, for which no penalty (other than a forfeiture) is provided in this Act, by a fine of not more than $10,000 or by imprisonment for a term not exceeding one year, or both; except that any person, having been once convicted of an offense punishable under this section, who is subsequently convicted of violating any provision of this Act punishable under this section, shall be punished by a fine of not more than $10,000 or by imprisonment for a term not exceeding two years; or both.

Any person who willfully and knowingly violates any rule, regulation or restriction made by the Commission under authority of this Act, or any rule, regulation or restriction made by any international communications treaty to which the United States is or may hereafter become a party, shall, in addition to any other penalties provided by law, be punished, upon conviction thereof, by a fine of not more than $500 for each and every day during which such offense occurs.

Q. 20. Define "harmful interference". (ART.)

A. 20. Harmful interference is any emission, radiation or induction which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunication service.

WAMH EXAM

Answer the following question(s) by writing all relevant (required) information on the log sheet you have been given.

Mr. Robert Thomas, a deranged Amherst student, got very drunk one night. In-fact he was so drunk, that instead of returning to his room to sleep he accidently stumbled into the Master Control Room of WAMH where he passed out. He awoke, suprisingly sober when the six-nine a.m. d, arrived at 5:55.

Still too tired to get up, yet fully awake, Mr. Thomas observed the following. The dj went over to the Remote Control panel and pressed some buttons, soon the meters in the station jumped up, this happened at 5:58. The dj, whose name was Cool Bob (his license read Robert James Warren) got some records ready and went on mike. He noted that this was "WAMH in Amherst" and played a cart about the show on WAMH "International Perspectives". He played a set of music, and during that time he took some meter readings. Thomas, an extremely inquisitive individual, noted that the readings were Volts 2100 , Amps .134 , %Power 100%; this happened at 6:12. At 617 Warren went on mike reading the Weather and a piece of paper which had a big'N' on the top and said on the bottom "Amherst Action Coalition .20". Warren also mentioned that the audience was listening to "WAMH progressive radio in Amherst". Another set of music and Cool Bob goes on mike again, this time at 6:24 . After rapping for awhile he presses a button and looks at cart machine 2 which presently contains something labeled "Straight Ahead 35". Unfortunately the machine doesn't work, and Bob moves on to the next set.

At 647 Cool Bob is back on mike. He does theweather, plays the cart that was supposed to be aired before, and reads one labeled " H Amherst Collge". He also says,"At 89.3 you are tuned to WAMH, owned an operated by the Trustees of Amherst College , in Amherst". At 7: a.m. Bob says this is'WAMH in Amherst etc'. He also reads an announcement about WAMH Midnite Album. At 7:12 he takes more meter readings . This time the meters read volts 2040 amps .120 % power 88%. Realizing (As all good d 's should) that this is too low he raises the power and takes another set of metrer readings. These are V-2140 A-.130 %P-101% .(this secind set of readings occurred at 7:15).

* On the attached sheets of paper and the log , you should now make up a paragraph like the ones above, and the appropriate log entries from 7:15 am until ~~8:50~~ am.
8:00

* We now continue the saga of Robert Thomas:

At 8:30 am Mr. Thomas and Mr. Warren were joined by the Newscaster Mr. Smith (no relation to the college). At 8:30 the newscaster began his intro," this is the news from WAMH Amherst Im Jim Smith". He finishes the show at 8:34 and at 9:00 xxxxxxxxxxxxxxxxxxxxx the new dj Vince Micheals goes on mike and does a legal ID. He does not read the weather He continues his show (Mr. Thomas temporarily passed out and did not wake up until 11:30 and we thus have no information on it) , but at 1145 Mr. Thomas was startled by a noise coming out of a little speaker that said," This has been a test of the Emergency Boredcast (~~bad diction~~) System this is WFCR-Amherst. At 11:47. our dj Vince air the WAMH version of the EBS test. After the test Vince airs (a little bit later than the scheduled time) a cart labeled "NIPAC 35" and reads the weather. He is replaced at noon by Jeff Sidney Strauss .

****** Fill in all relevant information for the time periods covered. Hint , there are a few things you have to write down that weren't explicitly indicated in the above passages.

Good luck!

FCC-TYPE EXAMINATION
ELEMENT 1

1. A response to a Notice of Violation must be made within:
   a. 10 days c. 3 days
   b. 24 hours d. 30 days

2. After receipt of a Notification of Suspension, the suspension order becomes effective within:
   a. 24 hours c. 3 days
   b. 30 days d. 15 days

3. The urgency signal is second in priority to:
   a. Communications relative to direction-finding bearings
   b. Communications preceded by a safety signal
   c. Distress calls, distress messages, and distress traffic
   d. Important international commerce bulletins

4. Corrections in the radio log may be made by:
   a. An operator licensed by the FCC
   b. The person who made the initial entry
   c. A notary public
   d. A person familiar with the operation of the installation

5. Radio stations are subject to inspection by:
   a. Any federal agency
   b. The Federal Bureau of Investigation
   c. The Federal Communications Commission
   d. The Federal Radio and Wire Authority

6. An application for renewal of a radio operator's license may be made:
   a. 15 months before expiration of the current license
   b. Within a year of expiration of the current license
   c. At all times, if there have been no violations
   d. Within 15 days of issuance of the original license

7. The secrecy provisions of the law do not apply to:
   a. Commercial bulletins
   b. Danish bulletins
   c. Holders of 1st Class Radiotelephone Operator's Licenses
   d. Distress messages

8. A response to a Notice of Violation must be addressed to:
   a. Any office of the Federal Communications Commission
   b. Any police authority of the continental United States
   c. The office of the FCC that originated the official notice
   d. The nearest Federal District Court

9. A person who has received an order of suspension may:
   a. Disregard the violation if he feels it to be unjust
   b. Request a hearing
   c. Order a court injunction on the FCC office
   d. Operate with an input power of less than 1 kilowatt

10. False signals of distress are:
    a. Allowed only if very low power is used
    b. Prohibited by law
    c. Common practical jokes among experienced operators
    d. Good tests of rescue facilities

11. Applicants for FCC licenses must generally be:
    a. Citizens of the United States only
    b. Citizens of the United States and Canada only
    c. Citizens of any country, provided they have held a radio operator's license of their respective country
    d. Citizens of English speaking countries

12. The usual license term for a radio operator is:
    a. one year c. three years
    b. two years d. five years

13. The second class radiotelephone license of a radio operator who qualifies for a first class license is:
    a. Kept in force for a period of one year
    b. Automatically cancelled
    c. Kept in force as long as the first class license is valid
    d. Kept in force for a period of two years

14. An operator who loses a license must:
    a. Not operate until he receives a duplicate
    b. Notify the FCC within 15 days
    c. Exhibit a copy of his application for a duplicate license while continuing to operate the station pending receipt of the duplicate license.
    d. Notify (within 10 days) the field office that issued the orginal license

15. Which of the following need not be done in correcting an error in a log:
    a. Indicate date of correction
    b. Indicate time of correction
    c. Initial the correction
    d. Strike out erroneous portion

16. Unidentified or superfluous radio communications may:
    a. Be transmitted on frequencies above 30 MHz.

- b. Not be transmitted at all
- c. Be transmitted on frequencies that are not used for distress, urgent or safety signals.
- d. None of the above

17. A person who willfully violates a provision of the Communications Act of 1934 faces a penalty of:
    - a. Not more than $500 fine
    - b. Not more than $10, 000 fine
    - c. Not more than $10, 000 fine and imprisonment for a term not exceeding one year
    - d. Not more than $5, 000 fine and imprisonment for a term not exceeding two years

18. Any person who knowingly violates a rule made by the Federal Communications Commission, shall, in addition to other penalties provided by law, receive a fine of not more than:
    - a. $500 for each day during which the offense occurs
    - b. $1000 for each day during which the offense occurs
    - c. $50 for each day during which the offense occurs
    - d. None of the above

19. A licensee who receives a notice that he has violated an FCC rule, must:
    - a. Send a written answer to the FCC in Washington, D. C. within 10 days.
    - b. Send a written answer to the FCC in Washington, D. C. within 15 days
    - c. Send a written answer to the FCC office originating the notice within 10 days.
    - d. Send a written answer to the FCC office originating the notice within 15 days.

20. The FCC may not suspend an operator license upon proof that the licensee:
    - a. Has failed to carry out a lawful order of the master of the ship on which he is employed.
    - b. Has transmitted superfluous radio communications
    - c. Has assisted another to obtain an operator's license by fraudulent means
    - d. None of the above

FCC-TYPE EXAMINATION

ELEMENT 2—SERIES "O"

1. The word "OVER" indicates:
    - a. The conclusion of a series of transmissions
    - b. The station is leaving the air temporarily
    - c. The transmission is over and no response is expected
    - d. The transmission is over and a reply is expected

2. The system of substituting words for corresponding letters is known as:
    - a. The Dewey system
    - b. The substitute transmission method
    - c. The phonetic system
    - d. The safety-sending method

3. The word "OUT" means:
    - a. The station is being interfered with
    - b. The station is leaving the air
    - c. The transmission is ended and a response is expected
    - d. The transmission is concluded and no response is expected

4. Shouting into a microphone may cause:
    - a. Deattenuation
    - b. Amplification
    - c. Rectification
    - d. Overmodulation

5. When speaking into a microphone in a noisy location, it is good practice to:
    - a. Shield the microphone with the hands
    - b. Shout directly into the microphone
    - c. Turn down the audio gain control
    - d. Speak very softly

6. Unnecessary calling should be avoided since it may cause:
    - a. Overmodulation
    - b. Interference with other stations
    - c. Electro-magnetic decoupling
    - d. Antenna wear

7. In radiotelephony, the words "READ BACK" mean:
    - a. I am repeating my previous transmission
    - b. This transmission is being read
    - c. Repeat the entire message back to me exactly as you have received it
    - d. This is a "copied" transmission, not an original reading.

8. A separation between portions of a single transmission should be indicated by inserting the word:
   - a. SEPARATE
   - b. STOP
   - c. BREAK
   - d. SECURITY

9. The licensed operator of a ship's radiotelephone station exhibits his authority to operate by:
   - a. Wearing a lapel pin with his registration number
   - b. Printing circulars with his qualifications stated plainly
   - c. Demonstrating proficiency in reception of American Morse Code
   - d. Posting his license conspicuously at the principal location of the station

10. All calling should be:
    - a. Lengthy and detailed
    - b. Done on working frequencies
    - c. Clear and concise
    - d. Repeated several times

11. When voice transmissions are not being made, the transmitter should be:
    - a. Dismantled
    - b. Moved away from windows, air vents, etc.
    - c. Kept on the air
    - d. Kept off the air

12. If an operator is told that his voice is distorting, he should:
    - a. Speak more softly or back away from the microphone
    - b. Report the insult to the FCC
    - c. Dismantle the modulator immediately
    - d. Use A1 emission promptly

13. An operator will find specifications for obstruction marking and lighting for antenna towers in:
    - a. The Communications Act of 1934
    - b. Part 17 of the FCC Rules and Regulations
    - c. The Geneva Radio Regulations of 1934
    - d. The bulletins issued by the nearest FCC office

14. In the event of an emergency, an operator may:
    - a. Increase his power in excess of the amount specified in the instrument of authorization
    - b. Utilize his station in a manner other than that specified in the instrument of authorization
    - c. Not utilize his station at all
    - d. Transmit on frequencies other than those specified in the instrument of authorization

15. When a person other than the licensed operator speaks into a microphone, responsibility for proper operation of the station is borne by:
    - a. The owner of the station
    - b. The licensed operator in charge of the station
    - c. The person himself, provided he is over 21 years of age
    - d. The person himself, provided he is over 18 years of age

16. In radiotelephone communications, a common expression "Repeat" means:
    - a. Speak slower
    - b. Say again
    - c. Repeat twice
    - d. Use the phonetic alphabet

17. An operator who leaves his station unattended in a public place:
    - a. Is not responsible for the transmitter when he is not present
    - b. Must make it inaccessible to unauthorized persons
    - c. Must always leave another licensed operator with the transmitter during daytime hours
    - d. Must turn the transmitter off

18. An operator who hears profanity being used at his station need not:
    - a. End the transmission
    - b. Enter relevant details into the log
    - c. Repeat the incident to the FCC
    - d. Personally order a citizens arrest of the person uttering the profanity.

19. The word "Clear" when used in radiotelephone indicates that:
    - a. The transmission is completed and no response is expected
    - b. The immediately preceding message has been received and is completely understood
    - c. The transmission is completed and a response is expected
    - d. The next message has nothing to do with the previous message.

20. In testing a radiotelephone transmitter, an operator should not:
    - a. Clearly indicate that he is testing
    - b. Give the station call sign
    - c. Interfere with other communications
    - d. Test for as short a time as possible

FCC-TYPE EXAMINATION
ELEMENT 9

1. The percentage of modulation on negative peaks of frequent recurrence in an FM transmitter must not be more than:
   - a. 50%
   - b. 75%
   - c. 85%
   - d. 100%

2. 18 milliamperes is equal to:
   - a. 18000 amperes
   - b. .018 amperes
   - c. 1.8 amperes
   - d. .18 amperes

3. Using the indirect method, what is the operating power of a transmitter with an efficiency factor of 0.65, whose last RF stage has a plate voltage of 850 volts and a plate current of 60 ma.
   - a. 33 watts
   - b. 33,150 watts
   - c. 51 watts
   - d. 51,000 watts

4. Abbreviations may be used in a log:
   - a. Only if the operator holds a first class radiotelephone license
   - b. Only if they are approved FCC-type abbreviations
   - c. If proper meaning or explanation is given elsewhere in the log
   - d. Abbreviations may not be used in a log.

5. Corrections in a manually kept operating log may be made:
   - a. only by the person making the original entry
   - b. By persons competent to do so, having actual knowledge of the facts
   - c. Only by the person in charge of the station
   - d. Corrections may not be made in a log

6. Station logs must be retained for a period of:
   - a. 1 year
   - b. 2 years
   - c. 3 years
   - d. 5 years

7. Logs pertaining to communications involving a disaster must be retained for a period of:
   - a. 2 years
   - b. 3 years
   - c. 5 years
   - d. until authorized by the FCC to destroy them

8. The following must be included in a station identification:
   - a. Call letters and location.
   - b. Call letters.

c. Call letters, location and time.
d. Call letters and time.

9. In general, station identification must be made:
a. At the beginning and end of each time of operation.
b. Every 15 minutes.
c. Every 30 minutes.
d. At the beginning and end of each time of operation and hourly, as close to the hour as feasible during a natural break in the program.

10. The Standard Broadcast Band refers to the band of frequencies from:
a. 500 kHz to 1600 kHz. c. 88 MHz to 108 MHz.
b. 535 kHz to 1605 kHz. d. 550 kHz to 1700 kHz.

11. An operator must announce that a recorded program is in fact recorded:
a. If the program lasts at least one half minute.
b. Even if it is obvious to all that the program is recorded.
c. If an attempt is made to create the impression that it is occurring simultaneously with the broadcast.
d. An announcer need not indicate the fact that a particular program is recorded.

12. E B S stands for:
a. Emergency Broadcast System.
b. Energy Broadband System.
c. Electronic Broadcast Service.
d. None of the above.

13. E B S test transmissions should be sent at least:
a. Once a week. c. Once each day.
b. Once a month. d. Twice a week.

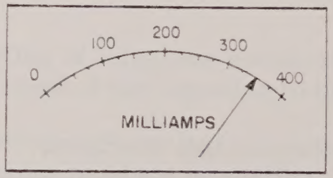
14. During a period of an Emergency Action Condition, non-participating stations:
a. Must continue their usual activity.
b. Must observe radio silence.
c. Must monitor specific stations.
d. Must keep their carriers on but stop modulation.

15. Tower lights shall be checked:
a. At least once each week.
b. At the beginning and end of each days activities.
c. At exactly one hour after sunset.
d. At least once each day.

16. If the tower lights fail, the operator must immediately notify the nearest:
a. Federal Aviation Agency office c. FCC office
b. Civil Air Patrol office d. E B S station

17. Which of the following exceeds the power limitations for a 25 kw. broadcast station?
a. 25.900 kw. c. 22, 600 watts
b. 23 kw. d. 26, 300 watts

18. The meter reads:
a. 350 amperes
b. 3.5 milliamperes
c. .35 amperes
d. 35 amperes



19. In making a log correction, the erroneous portion must be struck out, the corrections made, and:
a. the correction must be initialed.
b. the correction must be initialed and the date of correction must be entered.
c. the bottom of each page where corrections are made must be signed by the operator making the corrections.
d. slight corrections need not be initialed.

20. In the event of a malfunction of a part of the remote control equipment, the licensee:
a. must notify the nearest FCC office.
b. may operate for a period of 24 hours while repairs are being made.
c. must cease operation by remote control.
d. none of the above.

21. Using the direct method, what is the power of a broadcast station whose antenna resistance is 55 ohms, plate voltage of final stage is 2, 000 volts, plate current of final stage is 800 ma., antenna current is 5 A.?
a. 10, 000 W. b. 1280 W. c. 1600 W. d. 1375 W.

22. If the antenna base current ratio of an antenna tower (tower 1) is .4 and the base current of the reference tower (tower 2) is 5 amperes, what is the antenna base current in tower 1?
a. 0.8 A. b. 2 A. c. 1.25 A. d. 12.5 A.

23. Operator licenses may not be renewed:
a. during the final year of the license term.
b. within a year after the expiration of the license.
c. during the last two years of the license term.
d. none of the above.

24. A three-tower antenna system would be used at a:
   a. non-directional station   c. omnidirectional station
   b. directional station   d. tri-directional station

25. A "peak flasher" is used to indicate:
   a. modulation peaks   c. large frequency errors
   b. current peaks   d. excessive power

26. 850 volts is the same as:
   a. 8, 500 kilovolts   c. 850, 000 kilovolts
   b. 0.85 kilovolts   d. 8.5 kilovolts

27. What must an operator do if he notices an improper reading due to a malfunction of the remote control equipment?
   a. he must cease operating.
   b. he must switch his mode of operation.
   c. he must reduce his power until the malfunction is corrected.
   d. he must cease operating by remote control.

28. Where must an operator post his operator permit if he is employed at more than one station?
   a. at his principal place of employment.
   b. he need only post his permit at a station where he is the chief operator.
   c. he must post his permit or special form at all stations where he is employed.
   d. his permit must be kept in his possession at all times.

29. Programs transmitted by way of the Subsidiary Communications Authorization:
   a. must be received with a special multiplex receiver.
   b. are used only for the transmission of music.
   c. make use of a subchannel inserted 25 kHz outside the main FM channel assignment.
   d. must use monaural operation.

30. A broadcast station may transmit announcements promoting lotteries, provided:
   a. the sponsor is not a profit-making organization.
   b. the sponsor is a religious or fraternal organization.
   c. the selection of the lottery winner is carefully supervised.
   d. a broadcast station may not transmit announcements promoting lotteries.

31. When a commercial product is advertised, how must the sponsor be identified?
   a. by his corporate name.   b. by his trade name.
   c. by the product name.
   d. by any of the above, provided it is clear who the sponsor is.

32. An 8 watt FM broadcast station is required to log:
   a. the plate voltage and current of the final stage.
   b. the daily observations of the tower lights.
   c. the antenna base current.
   d. RF transmission line base reading.

33. If an operator's license is lost:
   a. he must cease operating until his new license is received.
   b. he must apply for a new license on FCC Form 736.
   c. a copy of his duplicate license application must be posted.
   d. he may continue to operate until his original license would have expired.

34. With regard to the broadcasting of telephone conversations:
   a. all parties must be informed of the intention to broadcast their calls.
   b. persons originating calls to programs that normally broadcast telephone conversations need not be notified.
   c. only station employees need not be notified.
   d. no one need be notified if the station is broadcasting to the general public.

35. Directional antenna systems do not generally:
   a. reduce interference.   b. use several towers.
   c. have the currents in each tower in phase with each other.
   d. increase the signal strength in the desired area.

36. What is the antenna base current ratio of an antenna tower if its base current is 7 amperes and the antenna base current in the reference tower is 4 amperes?
   a. .57   b. 28   c. 1.75   d. 2.8

37. Using the indirect method, what is the operating power of a broadcast station if the plate voltage of the last stage is 1500 volts, plate current is 700 ma., and efficiency factor is .7?
   a. 1050 watts   b. 735 watts   c. 105 watts   d. 7350 watts

38. 3.75 kilowatts are equal to:
   a. 375 watts   c. 0.0375 watts
   b. 37.5 watts   d. 3, 750 watts

39. A third class operator with a broadcast endorsement may make repairs to:
   a. prevent voltage fluctuations in the primary power supply.
   b. correct directional antenna malfunction.
   c. the antenna phasor equipment.   d. none of the above

40. If the operation of a transmitter is by remote control, what percentage of the remote controls and instruments must be readily accessible?
   a. 50%   b. 100%   c. 75%
   d. 100% of those dealing with power and frequency.

ANSWERS TO
FCC-TYPE EXAMINATIONS

ELEMENT 1

1. a
2. d
3. c
4. b
5. c
6. b
7. d
8. c
9. b
10. b
11. a
12. d
13. b
14. c
15. b
16. b
17. c
18. a
19. c
20. d

ELEMENT 2—SERIES "O"

1. d
2. c
3. d
4. d
5. a
6. b
7. c
8. c
9. d
10. c
11. d
12. a
13. b
14. b
15. b
16. b
17. b
18. d
19. a
20. c

ELEMENT 2—SERIES "M"

1. d
2. d
3. b
4. b
5. a
6. b
7. a
8. b
9. a
10. d
11. b
12. c
13. c
14. c
15. c
16. d
17. d
18. b
19. b
20. a

ELEMENT 9

1. d
2. b
3. a
4. c
5. a
6. b
7. d
8. a
9. d
10. b
11. c
12. a
13. a
14. b
15. d
16. a
17. d
18. c
19. b
20. c
21. d
22. b
23. c
24. b
25. a
26. b
27. d
28. c
29. a
30. d
31. d
32. b
33. c
34. b
35. c
36. c
37. b
38. d
39. d
40. b

WAMH-FM

AMHERST COLLEGE RADIO

Do not write inside

WAMH-FM
AMHERST COLLEGE RADIO

Do not write inside

ELEMENT 1
SERIES "O" AND "M"

Question 1. Where and how are FCC licenses and permits obtained? (R&R 13.11(a))

Answer 1. An operator's license or permit may be obtained by applying for a specific license at a regional office of the Federal Communications Commission. An examination must then be taken by the applicant, and if the examination is completed satisfactorily, a license is then issued to the applicant. An applicant for a restricted radiotelephone permit must fill out an application, but he is not required to take an examination.

Q. 2. When a licensee qualifies for a higher grade of FCC license or permit, what happens to the lesser grade license? (R&R 13.26)

A. 2. If the holder of a license qualifies for a higher class in the same group, the license held will be cancelled upon the issuance of the new license. Similarly, if the holder of a restricted operator permit qualifies for a first- or second-class operator license of the corresponding type, the permit held will be cancelled upon issuance of the new license.

Q. 3. Who may apply for an FCC license? (R&R 13.5(a))

A. 3. Normally, commercial licenses are issued only to citizens and other nationals of the United States. As an exception, in the case of an alien who holds an Aircraft Pilot Certificate issued by the Civil Aeronautics Administration or the Federal Aviation Agency and is lawfully in the United States, the Commission, if it finds that the public interest will be served thereby, may waive the requirement of the U. S. nationality.

Q. 4. If a license or permit is lost what action must be taken by the operator? (R & R 13.71, 13.72)

A. 4. He must immediately notify the FCC, and may then apply for a duplicate license. He must inform the Federal Communications Commission of the circumstances surrounding the loss of the original license, or how said license was destroyed. He must state that a reasonable search has been made for the original license, and that if it is found subsequent to the issuance of a duplicate, he will return either the original or the duplicate to the FCC for cancellation. He also must submit documentary evidence of the service performed under the original license.

Pending receipt of the duplicate license, the operator may operate the station, but he must exhibit a signed copy of the application (FCC Form 756) for the duplicate license.

Q. 5. What is the usual license term for radio operators? (R & R 13.4(a))

A. 5. Commercial operator licenses will normally be issued for a term of five years from the date of issuance.

Q. 6. What government agency inspects radio stations in the U.S.? (Sec. 303(n))

A. 6. The Federal Communications Commission.

Q. 7. When may a license be renewed? (R & R 13.11)

A. 7. It may be renewed at any time during the final year of the license term or during a one-year period of grace after the date of expiration of the license sought to be renewed. This is done by submitting Form 756 to the nearest FCC field office. If the renewal application is submitted before the license expires, the operator may continue to operate. However, he must post a duplicate copy of the renewal application in lieu of the original license, since the original license must accompany the application. During the one year period of grace, the expired license is not valid until the new license has been issued.

Q. 8. Who keeps the station logs? (R & R 73.111)

A. 8. Each log shall be kept by the person or persons competent to do so, having actual knowledge of the facts required.

Q. 9. Who corrects errors in the station logs? (R & R 73.111)

A. 9. Any necessary correction may be made only by the person originating the entry.

Q. 10. How may errors in the station logs be corrected? (R & R 3.111)

A. 10. Any necessary correction may be made only by the person originating the entry who shall strike out the erroneous portion, initial the correction made, and indicate the date of correction.

Q. 11. Under what conditions may messages be rebroadcast? (Sec. 325(a))

A. 11. Messages may be rebroadcast only with the express authority of the originating station.

Q. 12. What messages and signals--may not be transmitted? (R & R 13.66, 13.67, 13.68)

A. 12. No licensed radio operator shall transmit unnecessary, unidentified, or superfluous radio communications or signals. Neither shall he transmit communications containing obscene, indecent or profane words, language, or meaning. A licensed radio operator is prohibited from transmitting false or deceptive signals or communications by radio, or any call letter or signal which has not been assigned by proper authority to the radio station he is operating.

Q. 13. May an operator deliberately interfere with any radio communication or signal? (R & R 13.69)

A. 13. No.

Q. 14. What type of communication has top priority in the mobile service? (ART.)

A. 14. Distress calls, distress messages and distress traffic have top priority in the mobile service. Urgent signals are next in the order of priority, followed by safety signals.

Q. 15. What are the grounds for suspension of operator licenses? (Sec. 303(m)(1))

A. 15. The FCC may suspend an operator license upon proof sufficient to satisfy the Commission that the licensee:

(a) Has violated any provision of any Act, treaty or convention binding on the United States, which the Commission is authorized to administer, or any regulation made by the Commission under any such Act, treaty, or convention; or

(b) Has failed to carry out a lawful order of the master or person lawfully in charge of the ship or aircraft on which he is employed; or

(c) Has willfully damaged or permitted radio apparatus or installations to be damaged; or

(d) Has transmitted superfluous radio communications or signals or communications containing profane or obscene words, language, or meaning, or has knowingly transmitted ---

(1) False or deceptive signals or communications, or

(2) A call signal or letter which has not been assigned by proper authority to the station he is operating; or

(e) Has willfully or maliciously interfered with any other radio communications or signals; or

(f) Has obtained or attempted to obtain, or has assisted another to obtain or attempt to obtain, an operator's license by fraudulent means.

Q. 16. When may an operator divulge the contents of an intercepted message? (Sec. 605)

A. 16. An operator may divulge the contents of an intercepted message if the message is for the use of the general public or relating to ships in distress.

Q. 17. If a licensee is notified that he has violated an FCC rule or provision of the Communications Act of 1934, what must he do? (R & R 1.76)

A. 17. Within 10 days from receipt of notice, or such other period as may be specified, the licensee shall send a written answer, in duplicate, direct to the office of the Commission originating the official notice. If an answer cannot be sent or acknowledgment made within such 10-day period by reason of illness or other unavoidable circumstances, acknowledgment and answer shall be made at the earliest practicable date with a satisfactory explanation of the delay. The answer to each notice shall be complete in itself and shall not be abbreviated by reference to other communications or answers to other notices. In every instance, the answer shall contain a statement of action taken to correct the condition or omission complained of and to preclude its recurrence. In addition: (1) If the notice relates to violations that may be due to the physical or electrical characteristics of transmitting apparatus and any new apparatus is to be installed, the answer shall state the date such apparatus was ordered, the name of the manufacturer, and the promised date of delivery.

Q. 18. If a licensee receives a notice of suspension of his license, what must he do? (R & R 1.72)

A. 18. If a licensee receives a notice of suspension of his license, he must make a written application to the Commission within 15 days of receipt of the notice for a hearing on the suspension order.

Q. 19. What are the penalties provided for violating a provision of the Communications Act of 1934 or a Rule of the FCC? (Sec. 501, 502)

A. 19. Any person who willfully and knowingly violates the Communications Act of 1934 shall, upon conviction thereof, be punished for such offense, for which no penalty (other than a forfeiture) is provided in this Act, by a fine of not more than $10,000 or by imprisonment for a term not exceeding one year, or both; except that any person, having been once convicted of an offense punishable under this section, who is subsequently convicted of violating any provision of this Act punishable under this section, shall be punished by a fine of not more than $10,000 or by imprisonment for a term not exceeding two years; or both.

Any person who willfully and knowingly violates any rule, regulation or restriction made by the Commission under authority of this Act, or any rule, regulation or restriction made by any international communications treaty to which the United States is or may hereafter become a party, shall, in addition to any other penalties provided by law, be punished, upon conviction thereof, by a fine of not more than $500 for each and every day during which such offense occurs.

Q. 20. Define "harmful interference". (ART.)

A. 20. Harmful interference is any emission, radiation or induction which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunication service.

ELEMENT 2 — SERIES "O"

Ques. 1. What should an operator do when he leaves a transmitter unattended?

Ans. 1. Precautions should be taken so that the equipment will not be subjected to use by unauthorized personnel.

Q. 2. What are the meanings of: clear, out, over, roger, words twice, repeat, and break?

A. 2(a). "Clear" indicates that the transmission is completed, and that no response is expected.

(b) "Out" is similar in meaning to "clear". It indicates that the conversation is ended and no response is expected.

(c) "Over" indicates that the transmission has ended and a response is expected.

(d) "Roger" indicates that the immediately preceding message has been received, and is completely understood.

(e) "Words twice" is used to indicate that a series of words will be sent two times due to poor reception conditions or general communications difficulty.

(f) "Repeat" means to say again.

(g) The term "break" is used as a separation between parts of a single message.

Q. 3. How should a microphone be treated when used in noisy locations?

A. 3. It is good practice for the operator to shield the microphone with his hands when speaking into a microphone in a noisy location. This tends to cut down the microphone's picking up of background noise.

Q. 4. What may happen to the received signal when an operator has shouted into a microphone?

A. 4. Shouting into the microphone generally causes overmodulation. This results in speech distortion, as well as interference with stations on adjacent frequencies.

Q. 5. Why should radio transmitters be "off" when signals are not being transmitted?

A. 5. The transmitter should be off to prevent causing interference to other stations on the frequency.

Q. 6. Why should an operator use well-known words and phrases?

A. 6. Simple phrases and plain language are easier to understand. This reduces the number of errors that are made, and minimizes the amount of repetition necessary.

Q. 7. Why is the station's call sign transmitted?

A. 7. A station's call sign is transmitted so as to enable one to identify the station and thus avoid possible confusion. A proper station identification consists of the call letters and location of the station.

Q. 8. Where does an operator find specifications for obstruction marking and lighting (where required) for the antenna towers of a particular radio station?

A. 8. If an operator wishes to determine the specifications for obstruction marking and lighting of antenna towers, he should look in Part 17 of the Rules and Regulations of the FCC. If he wishes to determine the specifications for a particular station, he should examine the station authorization issued by the Commission.

Q. 9. What should an operator do if he hears profanity being used at his station?

A. 9. The licensed operator on duty should endeavor to end the transmission and should enter the relevant details in the log of the station. A report of the incident should be submitted to the FCC.

Q. 10. What should an operator do if the station he is calling does not answer within a reasonable length of time?

A. 10. He should stop calling and wait a reasonable length of time before attempting to call again. Continuous calling without results only causes interference and takes up valuable airways space that could be used by others.

Q. 11. When may an operator use his station without regard to certain provisions of his station license? (R & R 2.405)

A. 11. The licensee of any station, except amateur, may, during a period of emergency in which normal communication facilities are disrupted as a result of hurricane, flood, earthquake or similar disaster, utilize such station for emergency communication service in communicating in a manner other than that specified in the instrument of authorization: Provided: (a) That as soon as possible after the beginning of such emergency use, notice be sent to the Commission at Washington, D. C., and to the Engineer in Charge of the district in which the station is located, stating the nature of the emergency and the use to which the station is being put, and (b) That the emergency use of the station shall be discontinued as soon as substantially normal communication facilities are again available, and (c) That the Commission at Washington, D. C., and the Engineer in Charge shall be notified immediately

when such special use of the station is terminated.

Q. 12. Who bears the responsibility if an operator permits an unlicensed person to speak over his station?

A. 12. When a licensed operator in charge of a radiotelephone station permits another person to use the microphone and talk over the facilities of the station, he should remember that he continues to bear the responsibility for the proper operation of the station.

Q. 13. What is meant by a "phonetic alphabet" in radiotelephone communications?

A. 13. A phonetic alphabet is one in which a specific word is used to represent a letter of the alphabet; each letter has its corresponding word. For instance, the letter "A" may be made more easily recognizable by means of the word "Able", the word "Baker" is used to signify the letter "B", and the letter "C" is distinguished by use of the word "Charlie". By using one of the established phonetic symbols, the transmitting station makes clear to the receiving station exactly what letter is meant. This cuts down greatly on the amount of confusion and error, since many letters of the alphabet are similar in sound and may easily be confused.

Q. 14. How does the licensed operator of a station normally exhibit his authority to operate the station?

A. 14. An operator normally exhibits his authority to operate a station by posting a valid operator license or permit at the transmitter control point.

Q. 15. What precautions should be observed in testing a station on the air?

A. 15. In testing a radiotelephone transmitter, the operator should clearly indicate that he is testing, and the station call sign or name of the station, as required by the rules, should be clearly given. Tests should be as brief as possible. Caution should be observed by persons testing a station to make certain their test message will not interfere with other communications in progress on the same channel. Testing is important since it tells the operator whether the equipment is functioning properly. One of the primary duties of the operator is to maintain the equipment in proper operating condition.

ELEMENT 9

In recent years, Radiotelephone Third Class Operators with Broadcast Endorsements, have been given expanded privileges and duties. Some of these duties are somewhat technical in nature. To keep pace with these expanded duties, the FCC requires the Third Class Operator, with a Broadcast Endorsement, to have more technical knowledge than was previously required. The scope of the Element 9 examination has therefore been expanded to include additional technical and semi-technical questions.

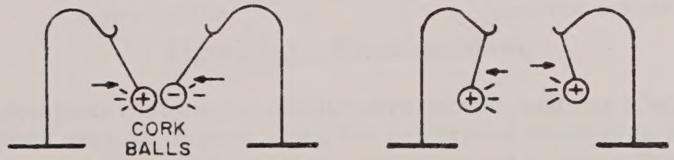
Previous editions of this book contained only the questions and answers given on Page 29. To meet the demand for the additional required knowledge, we are presenting the following basic information on radio theory. The prospective operator should be thoroughly familiar with the material contained in the questions and answers, as well as the basic radio theory.

The information in this book is sufficient for the prospective third class operator. However, if more technical information is desired, the AMECO "Commercial Radio Operator Theory Course" or "Radio Electronics Made Simple" publications can be consulted. These books are described on the back cover of this book.

BASIC RADIO THEORY

1-1 MATTER AND ELECTRICITY

Matter is a general term used to describe all the material things about us. Matter includes all man-made structures, woods, metals, gases, etc.; in other words, everything tangible. All matter, regardless of its size, quality or quantity, can be broken down fundamentally into two different types of particles. These particles, which are too small to be seen under a powerful microscope, are called ELECTRONS and PROTONS. Electrically, we say that the ELECTRON is NEGATIVELY charged and the PROTON is POSITIVELY charged. Also, the proton is about 1800 times as heavy as the electron.



A. Unlike charges attract. B. Like charges repel.

Figure 1-1. Attraction and repulsion.

1-2 THE LAW OF ELECTRIC CHARGES

Any object, such as a piece of glass, normally has a neutral or zero charge; that is, it contains as many electrons as protons. If this piece of glass can be made to have an excess of electrons, it is said to be negatively charged. Conversely, if the piece of glass can somehow be made to have a deficiency of electrons, the protons will predominate, and it is then said to be positively charged.

If a positively charged body is brought near a negatively charged body, the two objects will be drawn together. On the other hand, if two positively charged bodies or two negatively charged bodies are brought near each other, they will try to move away from each other. This reaction is the basis for our first law of electricity - the LAW OF ELECTRIC CHARGES. The law states "like charges repel, unlike charges attract". This law is illustrated by Figures 1-1A and 1-1B. In Figure 1-1A, a positively charged ball of cork is suspended by a piece of string near a negatively charged ball of cork. The two bodies swing toward each other since they attract each other. Figure 1-1B illustrates the two positively charged balls repelling each other.

1-3 DIFFERENCE OF POTENTIAL

If we were to connect a copper wire between the negative and the positive balls of cork, an electron flow would result. This is illustrated in Figure 1-2. The excess electrons from the negative ball would flow onto the positive ball where there is an electron deficiency and therefore, an attraction for the electrons. This flow continues until the deficiency and excess of electrons has disappeared and the balls become neutral or uncharged. This flow of electrons between the two differently charged bodies is caused by the difference in charge. A difference in charge between two objects will always result in the development of an electrical pressure between them. It is this electrical pressure that causes a current flow between these two bodies when they are connected by a piece of copper wire. This electrical pressure is defined as a DIFFERENCE OF POTENTIAL. The words "POTENTIAL" and "CHARGE" have similar meanings.

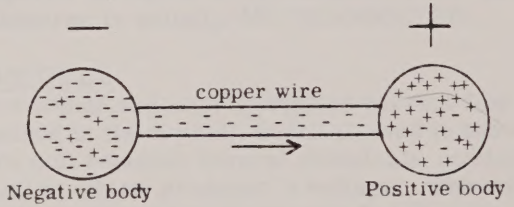


Figure 1-2. Flow of electrons.

1-4 CONDUCTORS AND INSULATORS

Materials through which current can easily flow are called CONDUCTORS. Most metals are good conductors. Conductors incorporate a large number of free electrons in their atomic structure. These free electrons are not held tightly and will move freely through the conductor when stimulated by external electrical pressure. Examples of good conductors, in the order of their conductivity, are silver, copper, aluminum and zinc.

Those materials through which current flows with difficulty are called INSULATORS. The electrons are tightly held in the atomic structure of an insulator and, therefore, cannot move about as freely as in conductors. Examples of insulators are wood, silk, glass and bakelite.

1-5 RESISTANCE

The ability of a material to oppose the flow of current is called RESISTANCE. All materials exhibit a certain amount of resistance to current flow. In order to compare the resistances of various materials, we require some standard unit of resistance measurement. The unit of resistance that was adapted for this purpose was the OHM, and the Greek letter Ω is its symbol. 1 ohm is defined as the amount of resistance inherent in 1,000 feet of #10 copper wire. For example, 5,000 feet of #10 copper wire would have a resistance of 5 ohms, 10,000 feet of #10 copper wire would have 10 ohms, etc. Although the ohm is the basic unit, the MEGOHM, meaning 1,000,000 ohms, is frequently used. The instrument used to measure resistance is the OHMMETER.

1-6 RESISTORS

The resistor is a common radio part with a built-in specific amount of resistance. Resistors which are made of mixtures of carbon and clay are called carbon resistors. Carbon resistors are used in low power circuits. Wire wound resistors, which contain special resistance wire, are used in high power circuits. Figure 1-3 illustrates several types of fixed resistors which are used in radio circuits, together with the symbol which is used to represent them in circuit diagrams. When it becomes necessary to vary the amount of resistance in a circuit, we use adjustable and VARIABLE RESISTORS.

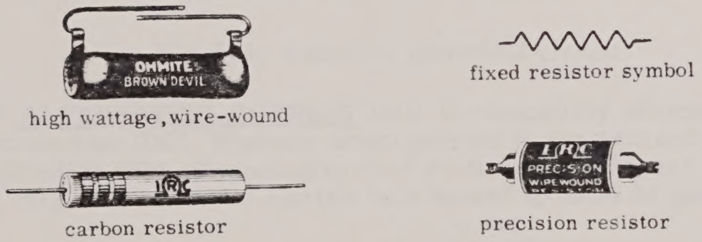
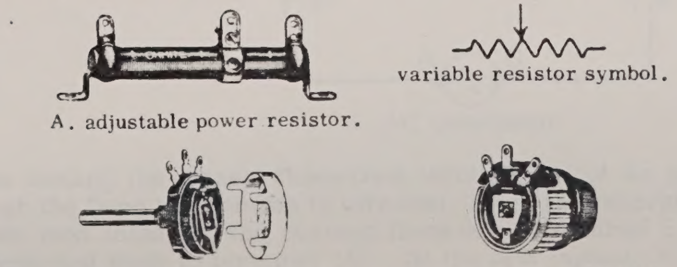


Figure 1-3. Fixed resistors.

The adjustable resistor is usually wire-wound, and has a sliding collar which may be moved along the resistance element to select any desired resistance value. It is then clamped in place. Figure 1-4A shows an adjustable resistor.


A. adjustable power resistor.

variable resistor symbol.

B. volume control potentiometer.

C. power supply rheostat.

Figure 1-4. Variable resistors.

Variable resistors are used in a circuit when a resistance value must be changed frequently. Variable resistors are commonly called potentiometers or rheostats, depending upon their use. The resistance is varied by sliding a metal contact across the resistance in such a way so as to get different amounts of resistance. The volume control in a radio is a typical example of a variable resistor. Figure 1-4 B shows a potentiometer used as a volume control for a radio receiver; Figure 1-4 C shows a potentiometer wound of heavier wire for use in a power supply circuit.

1-7 VOLTAGE AND CURRENT

Voltage is another term for the difference of potential or electrical pressure which we spoke about in a preceding paragraph. It is the force which pushes or forces electrons through a wire, just as water pressure forces water through a pipe. Some other terms used to denote voltage are EMF (electro-motive force), IR DROP and FALL OF POTENTIAL. The unit of voltage is the VOLT and the instrument used to measure voltage is the VOLTMETER. The KILOVOLT is equal to 1000 volts.

Current is the flow of electrons through a wire as a result of the application of a difference of potential. If a larger amount of electrons flow past a given point in a specified amount of time, we have a greater current flow. The unit of current is the AMPERE; it is equal to 6,300,000,000,000,000,000 electrons flowing past a point in one second. MILLIAMPERE and MICROAMPERE are terms used to denote one-thousandth and one-millionth of an ampere, respectively. Current is measured by an AMMETER. A meter whose scale is in milliamperes is called a MILLIAMMETER, and a meter that reads microamperes is called a MICROAMMETER.

1-8 THE DRY CELL

Several methods are used to produce current flow or electricity. A common method is the dry cell, which is used in the ordinary flashlight. The dry cell contains several chemicals combined to cause a chemical reaction which produces a voltage. The voltage produced by all dry cells, regardless of size, is 1-1/2 volts. A battery is composed of a number of cells. Therefore, a battery may be 3 volts, 6 volts, 7-1/2 volts, etc., depending upon the number of cells it contains. The fact that a cell is larger than another one indicates that the larger cell is capable of delivering current for a longer period of time than the smaller one. Figure 1-5 illustrates a typical 1-1/2 volt cell and a 45 volt battery. The 45 volt battery contains 30 cells.

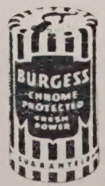


Fig. 1-5A. 1-1/2 v. flashlight cell.

BURGESS
BATTERY

Fig. 1-5B. 45 v. "B" battery.

Every cell has a negative and a positive terminal. The electrons leave the cell at the negative terminal, flow through the circuit, and return to the cell at the positive terminal. This type of current flow is known as DIRECT CURRENT (DC). Direct current flows only in ONE direction.

1-9 ELECTRICAL CIRCUITS

Figure 1-6 is a diagram of a complete electrical circuit. The arrows indicate the direction of the current flow. As long as we can trace the current from the negative point of the cell, all around the circuit and back to the positive point, we have a complete circuit. The important thing to remember is that current will only flow through a complete circuit.

The necessary parts for a complete circuit are:

(1) A source of voltage - the dry cell in Figure 1-6.
(2) Connecting leads - the copper wire conductors in Figure 1-6.
(3) A load - the bulb in Figure 1-6.

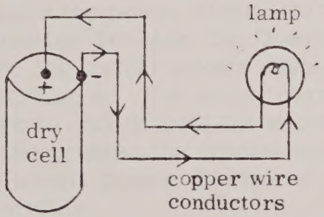


Fig. 1-6. Complete electrical circuit.

1-10 ALTERNATING CURRENT (AC) is completely different from direct current (DC). Whereas direct current is constant and flows in one direction only, alternating current continuously changes its direction. Fig. 1-7 shows an electric bulb hooked up to an AC generator.

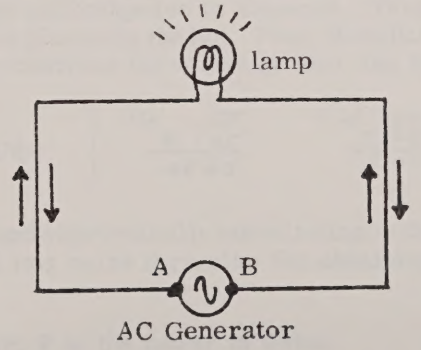


Figure 1-7.

At one instant, the current flows from terminal "A" of the generator, through the lamp and returns to terminal "B" of the generator. During the next instance, the current flows out of terminal B, through the lamp and back to terminal "A". At the next instant, it reverses itself, etc. etc.

Not only does alternating current reverse itself, as described above, it also continuously varies in strength from zero to some peak value. When an AC voltmeter reads AC voltage, it obviously does not read the instantaneous fluctuations; it reads its effective value.

Alternating current can be generated mechanically by an AC generator. It can also be generated by electronic means-by various tube and transistor circuits. Both AC and DC are present in a transmitter. However, the signal at the antenna that is to be transmitted is AC.

FREQUENCY. The flow of alternating current, first in one direction, then in the opposite direction, is called a complete "cycle". The frequency of alternating current is the number of complete cycles that occur in one second. The unit of frequency is cycles per second or simply cycles. The abbreviation for cycles per second is CPS. In recent years, the term "Hertz" (abbreviated "Hz"), has been used in place of cycles. The meter used to measure frequency is called a Frequency Meter.

The frequency of the AC power that is supplied to most homes in the United States is 60 Hertz. This is known as the POWER FREQUENCY. Radio waves transmitted by radio stations have a frequency much higher than the 60 Hz power frequency. Their frequency is generally above 20,000 Hz. An electrical frequency higher than 20,000 Hz is known as a RADIO FREQUENCY. The abbreviation for radio frequency is "RF".

Sound waves which can be heard by the human ear are called audible sounds or audio sounds. The frequency of the audio sounds lie in the range from 16 to 16,000 Hz. When a sound wave frequency is converted into an electrical frequency, it is known as an audio frequency (AF). For example, when our voice is amplified by a public address system, the sound waves from our throats strike the microphone and are converted into electrical frequencies, or audio frequencies.

When a frequency is given as a large number of Hz, it can be converted into smaller units of kiloHertz per second or MegaHertz per second, just as pennies can be converted into dollars. Example:

(a) 1,000 Hertz = 1 kiloHertz. The abbreviation for kiloHertz is "kHz". (The prefix kilo always means 1,000). Therefore, in order to convert Hertz into kiloHertz, we divide the number of Hertz by 1,000.

$$1{,}000{,}000 \text{ Hz} = \frac{1{,}000{,}000}{1{,}000} = 1{,}000 \text{ kHz}.$$

(b) 1,000,000 Hz = 1 MegaHertz. The abbreviation for MegaHertz is "MHz". Therefore, in order to convert Hertz into MegaHertz, we divide the number of Hertz by 1,000,000.

$$1{,}000{,}000 \text{ Hz} = \frac{1{,}000{,}000}{1{,}000{,}000} = 1 \text{ MHz}.$$

1-11 POWER

Whenever current flows through a resistance, there is friction

between the moving electrons and the molecules of the resistor. This friction causes heat to be generated, as does all friction. We could also say that electrical energy is changed to heat energy whenever current flows through a resistor. The unit of energy is the JOULE. The rate at which the heat energy is generated is the power that the resistor consumes. This power consumption in the form of heat represents a loss because we do not make use of the heat generated in radio circuits.

We should know how much heat power a resistor is consuming or dissipating. This is important because a resistor will burn up if it cannot stand the heat that is being generated by current flow. Resistors are, therefore, rated, not only in ohms, but in the amount of power that they can dissipate without overheating. The unit of electrical power is the WATT. A resistor rated at 5 watts is one which can safely dissipate up to 5 watts of power. If this resistor is forced to dissipate 10 watts, by increased current flow, it will burn up.

Exactly how much power is dissipated in a particular circuit, and upon what factors does the power dissipation depend? Since the power is the result of friction between the flowing electrons and the resistance in the circuit, the actual power dissipated depends upon the current and the resistance. The more current that flows, the more electrons there are to collide with the molecules of the resistance material. Also, the greater the resistance, the greater is the resulting friction. The actual power dissipated in a resistor can be found by the following formula:

$P = I^2 \times R$ where: P is the power in watts
(I^2 means I x I) I is the current in amperes
R is the resistance in ohms

Problem: Find the power dissipated in a 2000 ohm resistor with 50 milliamperes flowing through it.

Solution: First change milliamperes to amperes. This is done by moving the decimal three places to the left. Thus 50 milliamperes equals .05 ampere. Then substitute the values given in the formula.

(1) $P = I^2 \times R$
(2) $P = .05 \times .05 \times 2000$
(3) $P = 5$ watts

(1) .05
x .05
.0025

(2) .0025
x 2000
5.0000

By using Ohm's law and algebraically substituting in the above formula, we can arrive at two more formulas for obtaining power dissipation.

$P = E \times I$
$P = \frac{E^2}{R}$

where: P is the power in watts,
E is the voltage in volts,
I is the current in amperes and
R is the resistance in ohms.

The Wattmeter is the instrument that is used to measure power. The Watt-hour meter is the instrument that is used to measure energy.

INTRODUCTION TO TRANSMISSION AND RECEPTION

The diagram in Figure 8 represents a bird's eye view of a complete communications system. Instead of drawing out the individual circuits, a series of boxes are drawn. Each box represents a stage. (A stage is a tube or transistor with its associated parts.) The function of each stage is printed inside the box. Such a diagram is known as a block diagram.

Fig. 8-A illustrates a block diagram of a radio-telephone transmitter. Let us see briefly what the function is of each stage outlined in the block diagram. The heart of the transmitter is the oscillator. Its sole purpose is to generate a high frequency alternating current. This high frequency AC is called radio frequency or RF. The output of the oscillator is fed to the radio frequency amplifier which simply amplifies the RF output from the oscillator. The output of the RF amplifier is then fed to the RF power amplifier. The RF power amplifier amplifies the RF in terms of power. The power amplifier then supplies the antenna with the RF power that is to be radiated into space. Up to this point, we have only discussed the generation and transmission of a radio frequency wave which, by itself, contains no intelligence. The intelligence that we desire to transmit is the audio in the form of voice or music. Let us see how the audio is radiated into space.

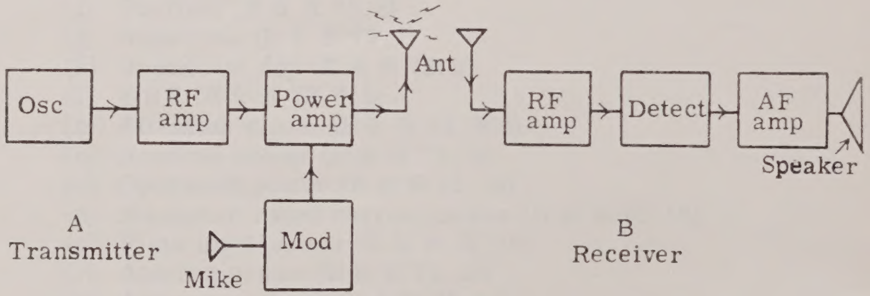


Figure 8. Radio transmitter and receiver.

The function of the microphone is to convert sound energy into electrical energy. The output of the microphone is applied to the modulator, which is simply an audio amplifier. The modulator serves two functions: (1) it amplifies the weak audio output of the microphone and (2) it superimposes the audio onto the radio frequency energy that is present at the power amplifier stage, by a process called modulation. The audio is combined with the RF wave because an audio wave by itself is not capable of traveling through space. High frequency such as RF, however, is capable of traveling through space. Therefore, the RF acts as the "carrier" for the audio; the RF carries the audio from the transmitter to the receiver. The combined audio RF output of the power amplifier is fed to the antenna where it is radiated out into space in the form of electromagnetic waves.

At the receiving end of the communications system, the electro-

magnetic waves induce small voltages into the receiving antenna. These signal voltages are quite weak because the electromagnetic waves have travelled some distance before striking the receiving antenna. Therefore, the signal voltages must be amplified; this is the function of the first stage in the receiver called the RF amplifier. The output of this stage is applied to the detector. Just as the oscillator is the heart of the transmitter, the detector is the heart of the receiver. The detector stage separates the audio from the RF carrier. The carrier has served its purpose in bringing the audio to the receiver. Now, all we are interested in is the audio. The audio output of the detector is then fed to an audio amplifier stage to be amplified. The amplified audio is applied to a speaker which converts the audio electrical variations back into the original sound that energized the microphone of the transmitter.

ELEMENT 9*

Question 1. What is meant by the following words or phrases?
(a) Standard broadcast station (AM) (R & R 73.1)
(b) Standard broadcast band (R & R 73.2)
(c) Standard broadcast channel (R & R 73.3)
(d) FM station (R & R 73.310)
(e) FM band (R & R 73.310)
(f) FM Stereophonic Broadcast (R & R 73.310)
(g) FM Subsidiary Communications Authorization (SCA) (R & R 73.293)
(h) Sunrise and Sunset (R & R 73.8)
(i) Daytime (R & R 73.6)
(j) Nighttime (R & R 73.7)
(k) Broadcast day (R & R 73.9)
(l) EBS (R & R 73.912)
(m) Attention signal (R & R 73.906)
(n) Nominal power (R & R 73.14)
(o) Operating power (R & R 73.14)
(p) Maximum rated carrier power (R & R 73.14)
(q) Plate input power (R & R 73.14)
(r) Antenna power (R & R 73.14)
(s) Antenna current (R & R 73.14)
(t) Antenna resistance (R & R 73.14)
(u) Percentage modulation (amplitude) (R & R 73.14)

Answer 1(a). The term "standard broadcast station" (AM) means a broadcasting station licensed for the transmission of amplitude-modulated (voice type) emissions primarily intended to be received by the general public and operated on a channel in the band - 535 kiloHertz to 1605 kiloHertz.

(b) The term "standard broadcast band" means the band of frequencies between 535 kiloHertz and 1605 kiloHertz.

(c) The term "standard broadcast channel" means the band of frequencies occupied by the carrier and two side bands of a broadcast signal with the carrier frequency at the center. Channels shall be designated by their assigned carrier frequencies. The 107 carrier frequencies assigned to standard broadcast stations shall begin at 540 kiloHertz and be in successive steps of 10 kiloHertz.

(d) The term "FM station" means a station employing frequency modulation in the FM broadcast band and licensed primarily for the transmission of radiotelephone emissions intended to be received by the general public.

(e) The term "FM band" means the band of frequencies extending from 88 to 108 megaHertz, which includes those assigned to noncommercial educational broadcasting.

(f) The term "FM Stereophonic Broadcast" means the transmission of a stereophonic program by a single FM broadcast sta-

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*See note in Preface concerning Element 9 examination.

tion utilizing the main channel and a stereophonic subchannel.

(g) An "FM Subsidiary Communications Authorization" (SCA) is an authorization granted to an FM station for the simultaneous transmission of one or more signals on assigned subcarrier frequencies within the station's assigned channel. Special decoding equipment is required to receive program material furnished on the SCA subchannel. Such material, although broadcast related, is normally intended for paying subscribers.

(h) The terms "sunrise" and "sunset" mean, for each particular location and during any particular month, the time of sunrise and sunset as specified in the instrument of authorization. Specifying the times of sunrise and sunset on the station license is important because not all standard (AM) broadcast stations are permitted to operate at night. In order to control objectionable skywave interference, stations which are permitted to operate at night are frequently required to change their modes of operation. These changes may involve the use of directional antenna systems, a reduction in operating power, or both, and normally occur at the sunrise and sunset times, listed in the station license.

(i) The term "daytime" means the period of time between the local sunrise and the local sunset.

(j) The term "nighttime" means that period of time between local sunset and local sunrise.

(k) The term "broadcast day" means the period of time between local sunrise and 12 midnight, local standard time.

(l) "EBS" stands for Emergency Broadcast System. The Emergency Broadcast System consists of the facilities and personnel of nongovernment broadcast stations and interconnecting facilities which have been authorized by the Federal Communications Commission to operate in a controlled manner during a war, threat of war, state of public peril or disaster, or other national emergency.

(m) The "attention signal" is the signaling arrangement whereby standard, FM and television broadcast stations can actuate mute receivers for interstation receipt of emergency cueing announcements and broadcasts. It consists of two audio tones having fundamental frequencies of 853 and 960 Hertz and shall not vary over ±0.5 Hertz. The two tones, with specified frequency tolerances and harmonic distortion limits, modulate the transmitter simultaneously at no less than 40% for an automatic time period of not less than 20 seconds, nor longer than 25 seconds.

The total harmonic distortion of each of the audio tones shall not exceed 5%.

(n) "Nominal power" is the power of a standard broadcast station, as specified in a system of classification which includes the following values: 50 kW., 25 kW., 10 kW., 5 kW., 1 kW., 0.5 kW., 0.25 kW.

(o) Depending on the context within which it is employed, the term "operating power" may be synonymous with "nominal power" or "antenna power". The operating power for AM stations is normally the antenna input power and for FM stations, it is the transmitter output power.

(p) "Maximum rated carrier power" is the maximum power at which the transmitter can be operated satisfactorily, and is determined by the design of the transmitter and the type and number of vacuum tubes used in the last radio stage.

(q) "Plate input power" means the product of the direct plate voltage applied to the tubes in the last radio stage, and the total direct current flowing to the plates of these tubes, measured without modulation.

(r) "Antenna input power" or "antenna power" means the product of the square of the antenna current and the antenna resistance at the point where the current is measured.

(s) "Antenna current" means the radio-frequency current in the antenna with NO MODULATION.

(t) "Antenna resistance" means the total resistance of the transmitting antenna system at the operating frequency and at the point at which the antenna current is measured.

(u) "Percentage modulation" with respect to an amplitude modulated wave means the ratio of half the difference between the maximum and minimum amplitudes of the amplitude modulated wave to the average amplitude expressed in percentage.

Q. 2. Make the following transformations:

(a) Kilocycles to cycles.
(b) Kilovolts to volts.
(c) Milliamperes to amperes.
(d) Watts to kilowatts.

A. 2(a) One kilocycle (kc) is equal to 1,000 cycles (c). Therefore, in order to change kilocycles to cycles, we multiply by one thousand. In order to change cycles to kilocycles, we divide by one thousand. Examples: 3 kilocycles equals 3,000 cycles. 1.4 kilocycles equals 1,400 cycles. 500 cycles equals .5 kilocycle.

In recent years, the electronics industry has adopted the term "Hertz", abbreviated "Hz", to replace the term "cycles". Kilocycles has been replaced by "kiloHertz", abbreviated "kHz"; megacycles (meaning one million cycles), has been replaced by "MegaHertz", abbreviated "MHz".

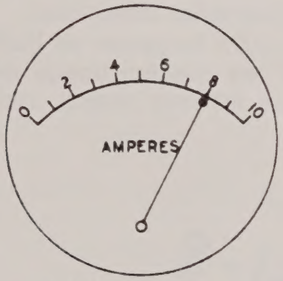
(b) One kilovolt is equal to 1,000 volts. Therefore, in order to change kilovolts (kv) to volts (v), we multiply by one thousand. In order to change volts to kilovolts, we divide by one thousand. Examples: 2.6 kilovolts equals 2,600 volts. 1 kilovolt equals 1,000 volts. 50 volts equals .050 kilovolt.

(c) One ampere is equal to 1,000 milliamperes. Therefore, in order to change milliamperes (ma.) to amperes (A), we divide by one thousand. In order to change amperes to milliamperes, we multiply by one thousand. Examples: 50 milliamperes equals .050 ampere. 200 milliamperes equals .2 ampere. .003 ampere equals

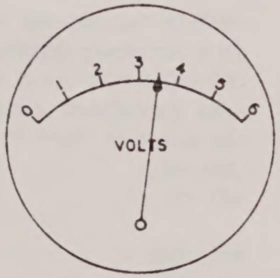
3 milliamperes.

(d) One kilowatt is equal to 1,000 watts. Therefore, in order to change watts to kilowatts, we divide by 1,000. In order to change kilowatts to watts, we multiply by 1,000. Examples: 3.4 kilowatts equals 3,400 watts. 250 watts equals .25 kilowatts.

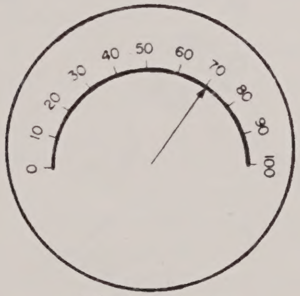
Q. 3. Draw the "face" of the following meters and know how to read each: (a) Ammeter. (b) Voltmeter. (c) Arbitrary scale meter. (d) Frequency monitor meter. (e) VU meter (for % modulation). (f) Milliammeter. (g) Antenna phase meter. (h) RF transmission line power meter.


0
2
4
6
8
10
AMPERES

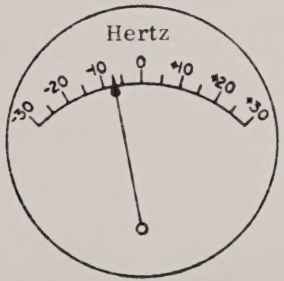
(a) Ammeter.
Reading shown
is 8 amperes.


0
2
3
4
5
6
VOLTS

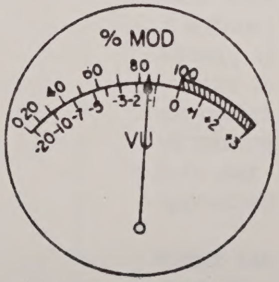
(b) Voltmeter.
Reading shown
is 3.5 volts.


0
10
20
30
40
50
60
70
80
90
100

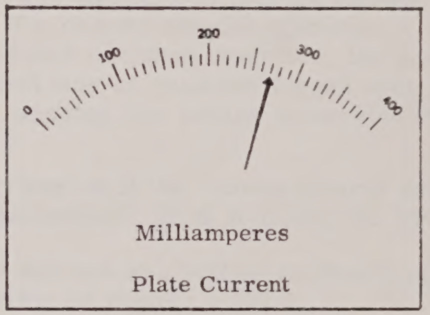
(c) Arbitrary
scale meter.


Hertz
-30
-20
-10
0
+10
+20
+30

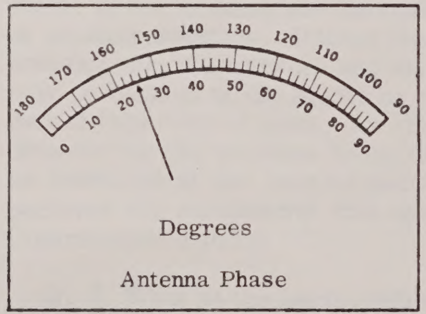
(d) Frequency Monitor
Meter indicates deviation in
Hertz. (kHz for FM stations)
Reading shown is -7 Hertz.


% MOD
0
20
40
60
80
100
-20
-10
-7
-5
-3
-2
-1
0
+1
+2
+3
VU

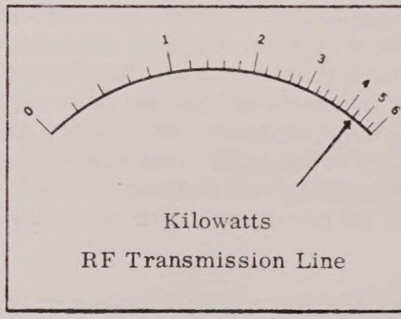
(e) VU Meter.
For % modulation, scale is
made larger than VU scale.
Reading shown is 85% mod.


0
100
200
300
400
Milliamperes
Plate Current

(f) Milliammeter.
Reading is 270 ma.


180
170
160
150
140
130
120
110
100
90
0
10
20
30
40
50
60
70
80
90
Degrees
Antenna Phase

(g) Antenna Phase Meter.
Reading on bottom scale
is 25 degrees.


0
1
2
3
4
5
6
Kilowatts
RF Transmission Line

(h) Transmission Line Wattmeter.
Reading is 4.5 kilowatts.

Q. 4. What indicating instruments are found in a broadcast transmitter? What should an operator know about these instruments? (R & R 73.39, 73.58, 73.258, 73.558)

A. Each transmitter is equipped with meters to indicate plate voltage and plate current. These meters indicate the operating constants of the transmitter amplifier. Each transmitter has normal operating levels of plate voltage and plate current and the operator should know what corrective actions should be taken when the meters indicate abnormal values.

At the place in the circuit where the antenna resistance or common point resistance is measured, an antenna ammeter is inserted to measure current into the antenna system. This meter is a direct indication as to whether the station is operating at, above, or below the licensed power. This meter indication should be maintained as close as possible to the licensed operating current and the operator should know what actions are necessary when the meter indications deviate from that value. Usually the antenna ammeter is located at the base of the tower and not easily accessible to the operator on duty. For this reason, most stations use a remote antenna ammeter which is located at the normal operating position of the person on duty. The remote antenna ammeter in-

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dication may be entered in the operating log, in lieu of the base current meter indication, provided the remote meter is calibrated once weekly.

All antenna current meters should be read when the transmitter is not being modulated. A break in programs is a good time to read the antenna current meters.

Q. 5. What should an operator do if the remote antenna ammeter becomes defective? (R & R 73.58)

A. If the remote antenna ammeter becomes defective, the antenna base currents may be read and logged once daily for each mode of operation, pending the return to service of the regular remote meter.

Additional information: (a) Each standard broadcast station shall be equipped with indicating instruments (which conform with the specifications set forth in Sec. 73.39) for measuring the DC plate circuit current and voltage of the last radio frequency amplified stage; the radio frequency base current of each antenna element; and, for stations employing directional antenna systems, the radio frequency current at the point of common input to the directional antenna.

(b) In the event that any one of these indicating instruments becomes defective when no substitute which conforms with the required specifications is available, the station may be operated without the defective instrument, pending its repair or replacement, for a period not in excess of 60 days without further authority of the Commission: Provided, That: (1) Appropriate entries shall be made in the maintenance log of the station, showing the date and time the meter was removed from and actually restored to service. (3) If the defective instrument is the antenna current meter of a nondirectional station which does not employ a remote antenna ammeter, or if the defective instrument is the common point meter of a station which employs a directional antenna, and does not employ a remote common point meter, the operating power shall be determined by the indirect method (in accordance with Sec. 73.52) during the entire time the station is operated without the antenna current meter or common point meter. However, if a remote antenna ammeter or a remote common point meter is employed and the antenna current meter or common point meter becomes defective, the remote meter may be used in determining operating power by the direct method, pending the return to service of the regular meter, provided other meters are maintained at same value previously employed.

(c) If conditions beyond the control of the licensee prevent the restoration of the meter to service within the above allowed period, informal request (in accordance with Sec. 1.549) may be filed with the Engineer-in-Charge of the radio district in which the station is located, for such additional time as may be required to complete repairs of the defective instrument.

(d) Remote antenna ammeters and remote common point meters are not required; therefore, authority to operate without them is not necessary. However, if a remote antenna ammeter or common point meter is employed and becomes defective, the antenna base currents (as stated above) may be read and logged once daily for each mode of operation, pending the return to service of the regular remote meter.

Q. 6. What should an operator do if the remote control devices at a station so equipped malfunction? (R & R 73.67, 73.274 and 73.575)

A. If the remote control devices at a station malfunction, the operator should cease operating by remote control.

Additional Information: Some broadcast stations have the main studio at one location and the transmitter and associated equipment at another location. Rather than have an operator on duty at the transmitter, the controls and metering functions of the transmitter may be located at the studio or other location and the operator on duty at this control point. A remote control authorization must be obtained by the licensee from the Commission. Equipment must be installed at the control point that will permit the operator to perform all monitoring and operating functions required by the Commission's rules.

Q. 7. What is the permissible % of modulation for AM and FM stations? (R & R 73.55, 73.268, 73.568)

A. Modulation in excess of 100% is called overmodulation. It is to be avoided because it causes interference in AM and FM transmission. It also causes distortion in AM transmission.

A low percentage of modulation is called undermodulation. Undermodulation is undesirable because it results in weak reception.

In both AM and FM, the percentage of modulation shall be maintained as high as possible, consistent with good quality of transmission and good broadcast practice.

In a standard (AM) broadcast station, the percentage of modulation is not to exceed 100% on negative peaks of frequent recurrence, or 125% on positive peaks at any time.

In FM, the percentage of modulation is not to exceed 100% on either positive or negative peaks of frequent recurrence.

In both AM and FM, the percentage of modulation should not be less than 85% on peaks of frequent occurrence; but where necessary to avoid objectionable loudness, modulation may be reduced to whatever level is necessary, even if the resulting modulation is substantially less than 85% on peaks of frequent occurrence.

Q. 8. What is the station requirement with respect to station monitors? (R& R 73.50, 73.56, 73.253, 73.268, 73.553, 73.568)

A. Each station must have in operation a modulation monitor which the operator uses to determine whether the modulation is at

the proper level. The modulation monitor consists of a meter and a peak flasher. The meter does not indicate the peak modulation, but indicates a value somewhat less than the peak modulation. The "peak flasher" indicates modulation peaks. Generally, the peak flasher is set so that when it flashes, it is an indication that the modulation is excessive and that corrective action must be taken by the operator.

Q. 9. What is the permissible frequency tolerance of standard broadcast stations? (R& R 73.59) Of FM stations? (R& R 73.269)

A. The operating frequency of each AM broadcast station should be maintained within 20 Hertz of the assigned frequency. The center frequency of each FM broadcast station should be maintained within 2,000 Hertz of the assigned center frequency.

Q. 10(a) How is the operating power of a standard broadcast station determined? (R& R 73.51) (b) What is the operating power of a normally operating standard (AM) broadcast station having a final plate voltage of 800 volts, a final plate current of 1000 ma., an antenna resistance of 52 ohms, an antenna current of 3.2 amperes and an F factor of 0.7. (c) How is the operating power of an FM station determined? (R & R 73.267) (d) Using the indirect method, what is the operating power of the above transmitter?

A. (a) (1) Except as provided in paragraph (2) of this section, the operating power shall be determined by the direct method (the square of the antenna current times the antenna resistance at the point where the current is measured and at the operating frequency). For example, if the antenna current is 4.2 amperes and the antenna resistance is 48 ohms, the operating power is:

$$4.2^2 \times 48 = 4.2 \times 4.2 \times 48 = 846.7 \text{ watts}$$

Non-directional AM broadcast stations employ only a single antenna tower. Power determined by the direct method is equal to the product of the antenna resistance and the square of the antenna current. Directional AM broadcast stations employ multiple radiating elements. Power determined by the direct method for these stations is equal to the product of the resistance common to all antenna towers (common point resistance) and the square of the current common to all antenna towers (common point current). At FM broadcast stations, if power is determined by the direct method, it is read directly from the RF transmission line meter. This meter must be calibrated each six months to give a direct indication of the power supplied to the antenna.

(2) Operating power shall be determined on a temporary basis by the indirect method: (i) In the case of an emergency where the licensed antenna system has been damaged by causes beyond the control of the licensee (see Sec. 73.45), or (ii) Pending completion of authorized changes in the antenna system, or (iii) If any change is made in the antenna system or any other change is made which may affect the antenna system. (See Sec. 73.45).

In the indirect method, the operating power or antenna power is found by the formula:

$$P = E_p \times I_p \times F.$$

where: E_p = plate voltage of last stage in volts, I_p = total plate current of last stage in amperes and F = efficiency factor. The efficiency factor is either given by the transmitter manufacturer or by a table in the Rules and Regulations (73.51).

For example, the operating power of a transmitter (using the indirect method), having a plate voltage of 2.8 kv, a plate current of 850 ma. and an "F" factor of .65, is:

$$2800 \text{ V} \times .85 \text{ A} \times .65 = 1547 \text{ watts or } 1.547 \text{ kw}.$$

Note that the voltage must be in volts and the current must be in amperes in order to use the formula properly.

(b) Since the direct method must be used, we used the power formula involving the antenna current (I) and the antenna resistance (R):

$$P = I^2R = (3.2)^2 \times 52 = 3.2 \times 3.2 \times 52 = 532.5 \text{ watts}.$$

(c) The operating power of an FM station is determined by using either the direct or the indirect method. Using the direct method, the power is measured by an RF transmission line meter at the output terminals of the transmitter, while operating into a dummy load of substantially zero reactance and a resistance equal to the transmission line characteristic impedance. The indirect method used for FM stations is the same as that used for AM stations.

(d) Using the indirect method formula, we can find the operating power:

$$P = E_p \times I_p \times F = 800 \times 1 \times .7 = 560 \text{ watts}.$$

Q. 11(a) What stations may be operated by a third class broadcast operator and what equipment adjustments may they perform? (b) What should be the normal operating position of a radio operator? (R & R 73.93, 73.265, 73.565)

A. Except for a very limited number of standard broadcast stations, using critical directional antenna arrays, licensees of AM and FM broadcast stations may employ third class operators for the routine station operations. However, if a station licensee elects to use third class operators, he is subject to many additional requirements. In most cases, a supervisory operator holding a Radiotelephone First-Class Operator's license must be employed either on a full-time or part-time basis.

The third class operator privileges do not include operation of television stations.

With the exceptions set forth below, adjustments of the transmitting system, inspection, maintenance, repairs, required equipment performance measurements and required field strength measurements must be performed only by a first-class radiotelephone

operator.

Except at times when the operation of the station is under the immediate supervision of an operator holding a valid radiotelephone first-class operator license, adjustments of the transmitting equipment by a third class operator shall be limited to the following:

(1) Those necessary to turn the transmitter on and off.

(2) Adjustments of external controls as may be required to compensate for voltage fluctuations in the power supply.

(3) Adjustments of external controls to maintain modulation of the transmitter within the prescribed limits.

(4) Adjustments of external controls necessary to effect routine changes in operating power which are required by the station's instrument of authorization.

(5) Adjustments of external controls necessary to effect operation in accordance with a National Defense Emergency Authorization during an Emergency Action Condition.

(6) Those necessary to change between nondirectional and directional or between differing radiation patterns, provided that such changes require only activation of switches and do not involve the manual tuning of the transmitter final amplifier or antenna phasor equipment. The switching equipment shall be so arranged that the failure of any relay in the directional antenna system to activate properly will cause the emissions of the station to terminate.

It shall be the responsibility of the licensee to insure that the person who may be required to perform these tasks, as well as to perform other duties (such as reading meters and making log entries) is properly instructed so as to be capable of performing the duties required of him at times when not under the immediate supervision of a radiotelephone first-class operator. Where necessary, printed step-by-step instructions shall be posted for those transmitter adjustments which the lesser grade operator is authorized to make. Should the transmitting apparatus be observed to be operating in any manner inconsistent with this subpart or the current instrument of authorization for the station at any time when an operator holding a valid radiotelephone first-class operator license is not immediately available, and none of the above adjustments is effective in correcting the condition of improper operation, the emissions of the station shall be immediately terminated.

(b) One or more operators holding a radio operator license or permit of a grade specified in this section, shall be in actual charge of the transmitting system, and shall be on duty either at the transmitter location or at the remote control point. If operation by remote control has not been authorized, the transmitter, required monitors and other required metering equipment, shall be readily accessible and located sufficiently close to the operator at the normal operating position that deviations from normal indications of required instruments can be observed within a 360° arc

from that position. If operation by remote control is authorized, the required controls and instruments shall be readily accessible, and located sufficiently close to the operator at the normal operating position that deviations from normal indications of required metering instruments can be observed in a 360° arc from that position.

Q. 12. What are the power limitations on broadcast stations? (R & R 73.52)

A. The actual antenna input power of each station shall be maintained as near as is practicable to the authorized antenna input power and shall not be less than 90 percent nor greater than 105 percent of the authorized power; except that, if, in an emergency, it becomes technically impossible to operate with the authorized power, the station may be operated with reduced power for a period of 10 days, or less, without further authority from the Commission. If causes beyond the control of the permittee or licensee prevent restoration of authorized power within the allowed period, informal written request shall be made to the Commission in Washington, D. C., no later than the 10th day for such additional time as may be deemed necessary.

Noncommercial educational FM broadcast stations licensed to operate with transmitter output power of 10 watts or less, may be operated at less than the authorized power, but not more than 105 percent of the authorized power.

Q. 13. What logs must be kept by broadcast stations according to the Rules and Regulations of the FCC? (R & R 73.111)

A. The licensee or permittee of each standard broadcast station shall maintain program, operating and maintenance logs. The logs shall be kept in an orderly and legible manner, in suitable form, and in such detail that the data required for the particular class of station concerned is readily available. Time entries shall be either in local standard or daylight saving time and shall be indicated accordingly. Each log sheet shall be numbered and dated. No log or preprinted log or schedule which becomes a log, or portion thereof, shall be erased, obliterated, or willfully destroyed within the period of retention provided by the provision of this part. Any necessary correction shall be made only pursuant to Sections 73.112 and 73.113, and only by striking out the erroneous portion, or by making a corrective explanation on the log or attachment to it, as provided in those sections. Entries shall be made in the logs as required by Sections 73.112 and 73.113.

The operating log and the maintenance log may be kept individually on the same sheet in one common log, at the option of the permittee or licensee.

Q. 14. Who keeps the logs? (R & R 73.111)

A. Each log shall be kept by the station employee or employees (or contract operator) competent to do so, having actual knowledge of the facts required, who in the case of program and operating logs, shall sign the appropriate log when starting duty, and again when going off duty.

Q. 15. What entries are made in the program log? (R& R 73.112) In the operating log? (R & R 73.113)

A. The following entries shall be made in the program log:

(1) For each program: an entry identifying the program by name or title, an entry of the time each program begins and ends, an entry classifying each program as to type (news, religious, entertainment, sports), an entry classifying each program as to source, an entry for each program presenting a political candidate showing the name and political affiliation for such candidate.

(2) For commercial matter: an entry identifying the sponsor(s) of the program, the person(s) who paid for the announcement, or the person(s) who furnished materials or services of any kind (such as records, transcriptions, talent, scripts, etc.), an entry showing the total duration of commercial matter in each hourly time segment (beginning on the hour) or the duration of each commercial message (commercial continuity in sponsored programs, or commercial announcements) in each hour, and an entry showing that the appropriate announcements (sponsorship, furnishing material, or services, etc.) have been made. A check-mark (✓) will suffice but shall be made in such a way as to indicate the matter to which it relates.

(3) For Public service announcements: an entry showing that a public service announcement has been broadcast, together with the name of the organization or interest on whose behalf it has been made.

(4) For other announcements: an entry of the time that each station identification is made (call letters and licensed location), an entry for each announcement presenting a political candidate showing the name and political affiliation of such candidate, an entry showing that a mechanical reproduction announcement has been made. The licensee, whether employing manual or automatic logging, or a combination thereof, must be accurately able to furnish the Commission with all information required to be logged.

Manually kept log. Where, in any program log, or preprinted program log, or program schedule which upon completion is used as a program log, a correction is made before the person keeping the log has signed the log upon going off duty, such correction, no matter by whom made, shall be initialed by the person keeping the log prior to his signing of the log when going off duty, as attesting to the fact that the log, as corrected, is an accurate representation of what was broadcast. If corrections or additions are made on the log after it has been so signed, explanation must be made on the log or on an attachment to it, dated and signed by either the person who kept the log, the station program director or manager, or an officer of the licensee.

An FM station, operating under a Subsidiary Communications Authorization (SCA), should include in the log, at least once a day, a general description of the program content. Any changes in the program content and times of changes, should also be logged.

The following entries shall be made in the operating log by the properly licensed operator in actual charge of the transmitting apparatus, or by automatic devices. (See (b) below.)

(1) An entry of the time the station begins to supply power to the antenna and the time it stops. (2) See Answer 26.

(3) An entry at the beginning of operation in each mode and at intervals not exceeding three hours, of the following (actual readings observed prior to making any adjustments to the equipment) and, when appropriate, an indication of corrections made to restore parameters to normal operating values: (i) Operating constants of last radio stage (total plate voltage and plate current). (ii) Antenna current or common point current (if directional) without modulation.

(4) An entry each day of the following where applicable: (i) Antenna base current(s) without modulation for each mode of operation: (a) Where remote antenna meters or a remote common point meter are normally employed but are defective. (b) Where required by the station license for directional antenna operation. (ii) Where there is remote control operation of a directional antenna station, readings for each pattern taken at the transmitter (within two hours of commencement or operation with each pattern) of: (a) Common point current without modulation. (b) Base current(s) without modulation. (c) Phase monitor sample loop current(s) without modulation. (d) Phase indications.

(5) Any other entries required by the instrument of authorization or the provisions of this part.

(6) The entries required by Section 17.49 and (c) of this chapter. (b) Automatic devices accurately calibrated and with appropriate time, date and circuit functions may be utilized to record the entries in the operating log: Provided, That: (1) They do not affect the operation of circuits or accuracy of indicating instruments of the equipment being recorded; (2) The recording devices have an accuracy equivalent to the accuracy of the indicating instruments; (3) The calibration is checked against the original indicators at least once a week and the results noted in the maintenance log; (4) Provision is made to actuate automatically an aural alarm circuit located near the operator on duty, if any of the automatic log readings are not within the tolerances or other requirements specified in the rules or instrument of authorization; (5) Devices which record each parameter in sequence must read each parameter at least once during each 10-minute period and clearly indicate the parameter being recorded; (6) The automatic logging equipment is located at the remote control point if the transmitter

is remotely controlled, or at the transmitter location if the transmitter is manually controlled; (7) The automatic logging equipment is located in the near vicinity of the operator on duty and is inspected by him periodically during the broadcast day; and (8) The indicating equipment conforms with the requirements of Sec. 73.39 except that the scales need not exceed 2 inches in length and arbitrary scales may not be used.

Manually kept log. Any necessary corrections in a manually kept operating log shall be made only by the person making the original entry who shall make and initial each correction prior to signing the log when going off duty, in accordance with 73.111(a). If corrections or additions are made on the log after it has been so signed, explanation must be made on the log or on an attachment to it, dated and signed by either the operator who kept the log, the station technical supervisor or an officer of the licensee.

FM stations, using the direct method of determining power, log the RF transmission line meter reading rather than the antenna current, as in AM stations.

An FM station operating under a Subsidiary Communications Authorization must keep a log of its operation. The log may be included as part of the operating log for the main channel or may be kept separately. Entries are required of the time the subcarrier generator is turned on and when it is turned off (excluding subcarrier interruptions of 5 minutes or less). An entry is also required for the time modulation is applied to the subcarrier and the time the modulation is removed from the subcarrier.

FM broadcast stations with an operating power of 10 watts or less are only required to log the time the station begins to supply power to the antenna, the time it stops, and entries concerning the daily observations of tower lights.

Q. 16. When may abbreviations be used in the station's logs? (R & R 73.111)

A. Key letters or abbreviations may be used if proper meaning or explanation is contained elsewhere in the log.

Q. 17. How may a station's logs be corrected?(R& R 73.111).

A. Any necessary correction to a station's logs may be made by striking out the erroneous portion, initialing the correction made, and indicating the date of correction. Also, see Answer 15 above.

Q. 18. According to the Rules and Regulations of the FCC, how long must station logs be retained? (R & R 73.115)

A. Logs of standard broadcast stations shall be retained by the licensee or permittee for a period of two years: Provided, however, That logs involving communications incident to a disaster or which include communications incident to or involved in an investigation by the Commission and concerning which the licensee or permittee has been notified, shall be retained by the licensee or permittee until he is specifically authorized in writing by the Commission to destroy them: Provided, further, That logs incident to or involved in any claim or complaint of which the licensee or permittee has notice, shall be retained by the licensee or permittee until such claim or complaint has been fully satisfied, or until the same has been barred by statute limiting the time for the filing of suits upon such claims.

Q. 19. What information must be given to an FCC inspector at any reasonable hour? (R & R 73.116)

A. The following shall be made available upon request by an authorized representative of the FCC: (a) Program, operating and maintenance logs. (b) Equipment performance measurements required by Sec. 73.47. (c) Copy of most recent antenna resistance or common-point impedance measurements submitted to the Commission. (d) Copy of most recent field intensity measurements to establish performance of directional antennas required by Sec. 73.151.

The above information must be made available for inspection by representatives of the FCC at any reasonable hour.

Q. 20. What must be included in a station identification and how often is it given? (R & R 73.1201)

A. Station identification shall consist of the station's call letters, immediately followed by the name of the community or communities, specified in its license as the station's location.

These identification announcements must be made: (1) At the beginning (sign-on) and ending (sign-off) of each time of operation, and (2) hourly, as close to the hour as feasible, at a natural break in program offerings. Television broadcast stations may make these announcements visually or aurally. The only legal requirement for "sign-on" or "sign-off" is the correct station identification.

Q. 21. What should an operator do if the modulation monitor becomes defective? (R & R 73.56)

A. (a) Each station shall have in operation, either at the transmitter or at the place the transmitter is controlled, a modulation monitor of a type approved by the Commission. (b) In the event that the modulation monitor becomes defective, the station may be operated without the monitor, pending its repair or replacement, for a period not in excess of 60 days without further authority of the Commission: Provided, That: (1) Appropriate entries shall be made in the maintenance log of the station showing the date and time the monitor was removed from and restored to service. (3) The degree of modulation of the station shall be monitored with a cathode ray oscilloscope or other acceptable means.

Q. 22. When should minor corrections to the transmitter be made? Before or after logging the meter readings? (R & R 73.113)

A. Minor corrections to the transmitter should be made after

logging the meter readings.

Q. 23. What must a broadcast station do when it transmits matter for which it receives compensation? (R & R 73.119 and 73.289)

A. When a broadcast station transmits matter for which it receives or expects to receive any compensation such as money, services, or other consideration, the station must announce that the matter is sponsored or furnished and also announce the name of the sponsor. However, when a commercial product or service is advertised, use of the sponsor's corporate name, trade name, or name of the product or service will suffice if it is clear that the product name identifies the sponsor. Broadcast station licensees are responsible to insure that their employees or others connected with program material are fully aware that accurate sponsor identification must be obtained and broadcast. Sponsored programs and announcements that do not promote a specific commercial service or product must also be identified by the name of the actual sponsor. Operators keeping program logs must be alert to insure that sponsored matter is announced at the time of the broadcast and the sponsor is correctly identified in the program log.

Q. 24. When should an operator announce a program as "recorded? (R & R 73.1208)

A. Any taped, filmed or recorded program material in which time is of special significance, or by which an affirmative attempt is made to create the impression that it is occurring simultaneously with the broadcast, shall be announced at the beginning as taped, filmed or recorded. The language of the announcement shall be clear and in terms commonly understood by the public. For television stations, the announcement may be made visually or aurally.

Taped, filmed or recorded announcements which are of a commercial, promotional or public service nature, need not be identified as taped, filmed or recorded.

Q. 25. How often should the tower lights be checked for proper operation? (R & R 17.47 and 17.98)

A. Once each day, the operator is required to check for the proper operation of the tower lighting system. Most tower lighting systems are turned on and off with an automatic actuation switch controlled by a photocell. Stations using the photocell are required to burn the lights continuously if the automatic actuation switch does not operate properly. Any observed or otherwise known outage or improper functioning of a code or rotating beacon light or top light not corrected in 30 minutes should be reported by telephone or telegraph to the nearest Flight Service Station or office of the Federal Aviation Administration. Notice should also be given to the Flight Service Station or FAA office when the situation has been corrected.

Q. 26. What record is kept of tower light operation? (R & R 17.49)

A. The licensee of any radio station which has an antenna structure requiring illumination, shall make the following entries in the station record of the inspections:

(a) The time the tower lights are turned on and off each day, if manually controlled;

(b) The time the daily check of proper operation of the tower lights was made, if automatic alarm system is not provided;

(c) In the event of any observed or otherwise known failure of a tower light: (1) Nature of such failure. (2) Date and time the failure was observed, or otherwise noted. (3) Date, time and nature of the adjustments, repairs or replacements made. (4) Identification of Flight Service Station (Federal Aviation Agency) notified of the failure of any code or rotating beacon light or top light not corrected within 30 minutes, and the date and time such notice was given. (5) Date and time notice was given to the Flight Service Station (Federal Aviation Agency) that the required illumination was resumed.

(d) Upon completion of the periodic inspection required at least once each three months: (1) The date of the inspection and the condition of all tower lights and associated tower lighting control devices, indicators and alarm systems. (2) Any adjustments, replacements or repairs made to insure compliance with the lighting requirements, and the date such adjustments, replacements or repairs were made.

Q. 27. What is an Emergency Action Notification? (EAN) (R & R 73.907)

A. The Emergency Action Notification is the notice (with or without an Attack Warning) to all licensees and regulated services of the Federal Communications Commission and to the general public, of the existence of an Emergency Action Condition. The Emergency Action Notification is released upon direction of the President of the United States, and is disseminated only via the Emergency Action Notification System.

Q. 28. What is an Emergency Action Condition? (R & R 73.908)

A. An Emergency Action Condition is the condition which exists after the transmission of an Emergency Action Notification and before the transmission of the Emergency Action Termination. It is actually a national, state or local area emergency situation posing a threat to the safety of life or property.

Q. 29. What equipment must be installed in broadcast stations in regard to reception of an Emergency Action Notification? (R & R 73.933)

A. (a) All broadcast station licensees must install and oper-

ate, during their hours of broadcast operation, equipment capable of receiving Emergency Action Notifications or Terminations transmitted by other radio broadcast stations. This equipment must be maintained in operative condition, including arrangements for human listening watch or automatic alarm devices, and shall have its termination at each transmitter control point. However, where more than one broadcast transmitter is controlled from a common point by the same operator, only one set of equipment is required at that point.

(b) The off-the-air monitoring assignment of each standard, FM and television broadcast station is specified in the Detailed State Emergency Broadcast System (EBS) Operational Plan. Particular attention should be paid to avoiding "closed loops" in monitoring assignments.

(c) Prior to commencing routine operation or originating any emissions under program test, equipment test, experimental, or other authorizations or for any other purpose, licensees or permittees shall first ascertain whether an Emergency Action Condition exists and, if so, shall operate only in accordance with the Basic Emergency Broadcast System (EBS) Plan and Detailed State Emergency Broadcast System (EBS) Operational Plan.

Q. 30. How often should EBS test transmissions be sent? During what time period are they sent? (R & R 73.910, 73.961)

A. EBS test transmissions of the Emergency Action Notification System will be conducted by standard, FM and television broadcast stations once each week on an unscheduled basis, between the hours of 8:30 A.M. and local sunset. These tests will be conducted in accordance with procedures set forth in the EBS check list furnished to all broadcast stations.

Q. 31. During a period of an Emergency Action Condition, what should all non-participating stations do? (R & R 73.932(a))

A. Non-participating stations must observe radio silence.

Q. 32. (a) What is meant by the term "rebroadcast"? (b) What is the rule regarding the rebroadcasting of a program of another broadcasting station? (R & R 73.1207)

A. (a) The term "rebroadcast" means reception by radio of the programs of a radio station, and the simultaneous or subsequent retransmission of such programs by a broadcast station.

(b) No broadcasting station shall rebroadcast the program, or any part thereof, of another broadcasting station without the express authority of the originating station. A copy of the written consent, of the licensee originating the program shall be kept by the licensee of the station rebroadcasting such program, and shall be made available to the Commission upon request.

Q. 33. What are the rules with regard to broadcasting lottery information? (R & R 73.1211)

A. Broadcast stations are prohibited from transmitting announcements or programs promoting or containing information that would promote lotteries. A lottery is any scheme in which money or a prize of value is awarded to a person selected by lot or chance, if a condition of winning is that a person must have furnished any money, purchased a product or service, or have in his possession a product sold by the sponsor of a program broadcast on the station in question.

The provisions stated above do not apply to a lottery conducted by a State acting under authority of State law when such information is broadcast: (1) by a radio or television broadcast station licensed to a location in that State, or (2) by a radio or television broadcast station licensed to a location in an adjacent State which also conducts such a lottery. Such State "lottery" means the pooling of proceeds derived from the sale of tickets or chances and allotting those proceeds or parts thereof by chance to one or more chance takers or ticket purchasers. It does not include the placing or accepting of bets or wagers on sporting events or contests.

Q. 34. If a license or permit is lost, what action must be taken by the operator? What is the usual license term for radio operators? When may a license be renewed? (R & R 13.4, 13.11, 13.71 and 13.72)

A. See answers to Questions 4, 5 and 7 of Element 1, Series "O" and "M".

Q. 35. Where does an operator post his permit? (R& R 73.92, 73.264 and 73.564)

A. The operator must post his permit or posting statement at the place where he is on duty at the transmitter control point. FCC Form 759 is a posting statement used by operators employed at more than one station. The permit is posted at one station and FCC Forms 759 are posted at other stations where the operator is employed. The station license and other operating authorizations must be posted at the transmitter control point with all terms visible.

Q. 36. What is the rule regarding the broadcasting of a telephone conversation? (R & R 73.1206)

A. Before broadcasting a telephone conversation or recording a telephone conversation for later broadcast, the parties to the conversation must be informed of the intention to broadcast the conversation. However, station employees who may be presumed to be aware that their telephone conversations are intended for broadcast are not required to be advised of the broadcasting of their calls. Also, no notice of broadcast is required for per-

sons originating calls to programs which normally broadcast telephone conversations coming into the program.

Q. 37. What is a Subsidiary Communications Authorization? For what purpose is it used? (R & R 73.293, 73.295, 73.297, 73.593, 73.595 and 73.596)

A. A Subsidiary Communications Authorization (SCA) is a permit to use a subchannel within the main FM channel assignment.

In addition to monaural operation, FM stations may elect to broadcast stereo programming. This is accomplished by inserting a subchannel within the FM channel. In addition to the stereophonic subchannel, an entirely different subchannel may also be used. Programs transmitted by way of the Subsidiary Communications Authorization cannot be received without a special multiplex receiver. Most SCA subcarriers are used for the transmission of subscription background music, such as the music that is broadcast to stores and factories by Muzak. Other SCA uses are for detailed weather forecasting, special time signals, and other material of a broadcast nature expressly designed and intended for business, professional, educational, religious, trade, labor, agriculture or other groups engaged in any lawful activity.

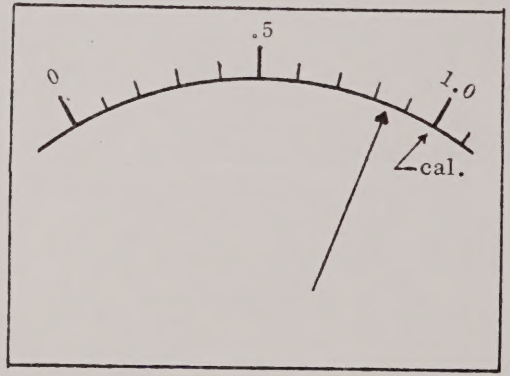
Q. 38(a) What is the basic difference between directional antenna systems and non-directional antenna systems? (b) How does the radio operator determine that a directional antenna is radiating according to a specified pattern? (c) Discuss phase differences and current ratios with respect to directional antenna systems. (R & R 73.69, 73.95)

A. (a) Non-directional AM stations use a single antenna tower and transmit the radio signal with equal strength in all directions from the station. Directional AM stations utilize more than one antenna tower. By establishing the position of each tower, the power radiated by each tower, and the phase of the signal in each tower, different signal strengths can be radiated in various directions. Directional antenna systems are used to improve the signal over desired areas and to reduce the signal in the direction of other stations to prevent interference.

(b) To determine if a directional antenna system is radiating the signal according to a specified radiation pattern, an instrument called an antenna monitor is installed at the station. The antenna monitor enables the operator to determine if the radio frequency (RF) current in each tower is of the correct value and if the phase of the signal radiated by each tower is also correct. Some antenna monitors indicate the ratio of current in each tower to the current in one tower called the reference tower.

(c) A radio frequency signal or current is actually an alternating current. In addition to reversing itself continuously, its actual instantaneous value is varying from zero to a certain amount. If the instantaneous peak values of the signals arrive at each tower at the exact same time, we say that the currents in each tower are "in phase" with each other. If the instantaneous peak values of the signals do NOT arrive at the towers at the exact same time, we say that the currents are "out of phase" with each other. The difference in time or phase is measured in degrees.

In most directional antenna systems, the currents in the various towers are out of phase with each other. The actual antenna currents (as read by ammeters), also tend to be different from each other. For each directional antenna tower, the station license contains a list of the required signal phases and antenna base current ratios. The antenna base current ratio for a tower is calculated by dividing the current meter reading for that tower by the current meter reading for the designated reference tower. The ratio, either calculated or read on the antenna monitor (see figure below), must not deviate more than 5 percent from the value on the station license. Operators on duty at AM stations, using directional antenna systems, should know how to read the antenna monitor meters, and should know how to use charts, tables or other instructions to determine if the station is operating correctly, if attention by the station's first class operator is required, or if the station must terminate operation.



Basic Antenna Current Ratio Meter.

The meter is set for "1.0" (cal.) by reading the current in the designated reference tower. The current is then taken for a given tower and its current ratio is then read on the meter. The meter can be in percentage or ratio. The above meter reads a ratio of .85.

F.C.C. LOGS

Most radio stations are required by the F.C.C. to maintain complete logs of programs, maintenance, and transmitter use at the station. WAMH must submit its logs to the FCC when license renewal is requested or to inspectors on demand. FCC logs are legal documents distinct from play lists kept by the station. It is sometimes possible to get away with sloppy logging at a radio station, and it has been done at WAMH in the past. It has always been tempting to crack down by having all DJs and techs return to the station at an additional time to rewrite their incorrect logs. This will be done at WAMH only if incorrect logging persists.

I. PROGRAM LOGGING

The program log must have many items, so that a complete account of the programs on the air at WAMH is made. The top of all program logs has identification of the station, place, frequency, and date. The body of the log gives the time each program or announcement begins, its source, its type, and its name; and the time of every station identification that is required (normally two per hour). Logs are organized into columns:

1. SI. In this column must be written the time of every station identification. Optional SIs may also be listed here if they are made. Note that the letters SI at the top of this column indicate the type, name, etc. without spelling them out, because we can use the abbreviation SI for whatever we want to, as long as all abbreviations are explained in an abbreviation key accompanying the logs. Therefore, normal SIs do not require anything at all to be written in any other column except the SI.

2. PROG. BEGIN. In this column must be written the time at which every program begins. The only other thing of any kind that may ever occur in this column is the meridian: "AM" or "PM". Every individual entry in this column must match with exactly one entry in each of the following columns: source, type, and program name. Thus these four pieces of required information must all be included as a single unit for each program, in line across that section of the page.

3. SORCE/TYPE. The source of each program and the type of each program must be included in the program log, one of each to match each entry in the program begin and program name columns. There are three possible sources at WAMH: T, R, and L. REC is not a source. (In fact, despite almost universal usage in the past, it isn't anything.) T means "transcribed." A program is transcribed only if it is, in its entirety, a program produced (made) elsewhere than at WAMH. Examples are live network shows patched into our transmitter via our board after having been assembled through a board elsewhere, public service announcements copied onto a cart with nothing added or changed from a tape our record made elsewhere, a DJ show on disc that contains the DJ commentary, the music, and everything else in one piece. There are many other possibilities. The only thing that can be added to a program so that it can still be logged as "T" is a station identification of WAMH at a required time that has no other extraneous talking or other material interrupting the transcribed program. (SIs are also required in a "T" program when (and if) the program contains the station identification of another radio station.)

R means "recorded." A program is recorded only if it is assembled from recorded and/or mixed live and recorded material at WAMH. Examples: a program consisting entirely of three Cream songs from various albums, or such a program with the DJ talking, or a talk show with music interludes or pre-recorded illustrations of a point. There are more possiblities.

L means "local." Local is the opposite of transcribed, and should be used if T and R do not apply to the program: i.e., when the program was made at WAMH and not consisting of or assembled from pre-recorded material. Examples are guitar played on mike in the next studio, pure talk, or the Midnight Sports; and there are of course others. -- There are seven possible types at WAMH: PS, PA, EN, ED, SI, SP, N. PS means "public service." PSA is not a type. This includes programs that are strictly in the public service and will usually mean only announcements made by WAMH in fulfilment of its obligation to inform the public. PA means "public affairs." This means programs about issues, controversial or otherwise but usually controversial, that are of concern to the public. A guideline for differentiating PA from PS is that PS may be considered as mention or promotion of an event, while PA is a show that is such an event. EN means "entertainment." A program is entertainment if its purpose is primarily to provide a source of interest for those with leisure time. EN programs may also, of course, have an educational theme, or attempt to broaden people's musical taste, or otherwise be constructive. ED means "educational." A program is to be logged ED only if its primary purpose is the education of the public in the narrow sense: i.e., do not log a program as educational if it can correctly be put in any other type. SI means "station identification." ID does not exist as an abbreviation anywhere in any WAMH log. A program is of type SI only if its primary purpose is the identification of WAMH. Normally the only programs logged SI are the sign-on and sign-off. SP means "sports." A program should be logged SP if it is about sports techniques, news, or opinion. N means "news." Programs consisting of news and commentary in the traditional sense should be logged N, even if they include some news about sports as a part of the whole that cannot easily be considered a distinct part to be logged SP. ##### The source and type both go in the source/type column, and must always be separated by a slant.

4. PROGRAM NAME. In this column must be written the program name. It is #####(this blank line is just to say Hi. Log guide authors are human!)### desirable for all programs to have a name, preferably sufficiently related to the content so that staff can tell which show it was. Music shows that do not have a name may be logged as Music: (DJ's name) . A succinct title is best, since description of the show is entirely unnecessary and the show could be named "weekly #39," as far as legal requirements are concerned, as long as that constitutes positive identification of the show. There are some special cases. One is public service announcements, or PSAs. The abbreviation PSA may only be used in a log in the program name column, and then only when part of a complete entry with these parts: an asterisk, the letters PSA, a colon, the sponsor's name in parentheses, and a colon plus the number of seconds duration of the announcement in parentheses. The asterisk is to indicate that the program is an announcement, that is, it is an interruption of a program that need not be re-logged when it resumes, or an interlude between two programs. The name of the program is Public Service Announcement, plus the sponsor's name as a modification so that the various PSAs can be told apart on the log. The sponsor's name must be the organization for whose benefit the PSA is aired. PSAs from the PSA notebook and from carts will hopefully be labelled with correct source, type, and sponsor. Always look for it. The definition of an announcement by the FCC includes the provision that announcements are less than sixty seconds in duration. Log different PSAs separately even if the sponsors are the same, if that is necessary to avoid duration over 60 seconds. We will try to avoid making available any PSA over 60, so that if you need to estimate the duration and it seems long, say "(:60)." Another special case is the sign-on or sign-off. You may call them as such, or as "Standard Sign-On" if you read the standard WAMH version word-for-word.

while keeping the RAISE button pushed. When that is done, recheck the zero, by releasing the RAISE button, and readjusting the ZERO control, if necessary. Then recheck the mid-scale calibration by pushing RAISE and adjusting the CALIBRATE control if necessary, as described above. Repeat this procedure until the meter rests exactly on zero with the raise button released, and exactly between the two little arrows with the RAISF button pushed. This may sound like a pain to do, but it is important, and since the calibration should not drift very much, adjustment should have to be made only relatively infrequently, but should be checked each time, as emphasized above.

PUSHBUTTON IDENTIFICATION:

Button number	meters(scale)	controls
1	filament voltage (0-2.5)	filaments on/off
2	plate voltage (0-2.5)	plate on/off
3	plate current (0-2.5)	none
4	power (percent scale)	power raise/lower
5	none	raise=stereo; lower=left mono
6	none	raise=stereo; lower=right mono
7	reflected power(percent)	none

Readings from the remote control will have to be taken and recorded for plate voltage, plate current and power, which we will determine by the indirect method. To determine whether our output power is within prescribed limits, we will have to take readings for plate current and plate voltage and using them, look up our power in the table posted by the remote control. The table will give you our power as a percentage of our authorized power. If the power is less than 90% or greater than 105%, the power will have to be adjusted. To do this, push position #4 and press RAISE or LOWER depending on which adjustment is needed. Hold the button in until you see the meter change slightly in the required direction, and then recalculate the power from the plate current and voltage using the table. Continue adjusting until the power as indicated in the table is between 90% and 105%. Position 4 meters power directly, but not accurately enough to satisfy FCC standards, so it is to be used only as a relative indication.

You must record in the transmitter log the time you started reading the meters, the observed plate voltage, plate current, and if you had to adjust the power, what the power was before you adjusted it to the prescribed limits, and what the plate voltage and plate current are after the adjustment.

Also to be recorded in the transmitter log is the indication on the frequency monitor. Make sure the button on the frequency monitor is in the MOD CARRIER position, and record the indication on the readout, including the indicated sign.

BUTTONS, in general...

There are lots of controls and buttons on the new equipment, which tend to get confusing. Most of them are not to be touched by non-technical people. Unless you are specifically told to do so in this notice, do not touch an unfamiliar control. Those controls which should be always in the same position will be marked with a red "+" by the proper position, in case the guy/gal before you moved it. If something doesn't appear to be indicating properly, check to see if all the indicated switches are in the proper positions, and that all pushbuttons are firmly depressed. If the problem is in the remote control, try hitting the RECYCLE button.

THE MODULATION MONITOR:

The modulation monitor will always read transmitter percent modulation (left channel in the left meter, total modulation in the center meter, and right channel in the right meter) with the switches in the normal operating position. A white "peak light" will flash when you exceed 100% total modulation. It is illegal to hit 100% modulation, as indicated by the peak light "on peaks of frequent occurence" as it says in the FCC Rules and Regs. This means that it is OK for this light to flash occasionally, but if it flashes a lot, turn your pots down. You do not have to record any meter readings from this monitor. The "19 khz" light will light when you are in stereo, and will go out if you switch to mono or the bulb burns out.

SIGNING THE TRANSMITTER ON THE AIR:

1) Press button 1 on the remote control, and wait for the read light to come back on. Push the RAISE button momentarily and then release it. The meter should jump up to about mid scale and stay there (actually it will rise to the value of the filament voltage or about 11 volts, but that's not important). The filaments are now on.

2) WAIT at least five minutes. Ten minutes would be better, especially in the winter. This allows sufficient time for the amplifier to warm up.

3) After the filaments have had a chance to warm up, push button 2 on the remote control. Then push the RAISE button momentarily and then release it. The meter should begin to indicate plate voltage. You are now on the air. In the event you did not wait at least three minutes for the filaments to warm up, in addition to endangering our transmitter's health, the plate might not come on at all when the RAISE button is pressed. If this happens, immediately press the LOWER button, wait another few minutes, and try RAISE again. It should work.

4) Now turn the modulation monitor on by the switch in the lower right hand corner of the instrument and turn the RF amplifier on with the pushbutton on its front panel (the RF amplifier is on top, the mod monitor on the ~~[illegible]~~ bottom, and the frequency monitor in the middle). The meters should kick around, then come to rest on or near zero on the modulation monitor, assuming you have nothing going over the board. You are now ready to read the sign-on.

NOTE: The transmitter will not reach full output power for about half an hour after it is turned on for the first time in the day, therefore, do not attempt to take meter readings or adjust the power until at least one hour into the show.

ALSO: The difference in signal strength between 90% and 105% on the table is very small, even unnoticeable, so do not try to push the power up to exactly 105% to try to reach Mt. Holyoke a bit better. It is both dangerous and ineffective. Adjust the power only if it lies outside the 90% to 105% range.

SIGNING THE TRANSMITTER OFF THE AIR:

1) After reading your sign-off, press position 2 on the remote control, and wait for the read light to come back on.

2) Press LOWER, and the meter needle (indicating plate voltage) should fall to zero. You are now off the air.

3) The modulation monitor meters will jump around and peg against their stops and the peak light will flash like crazy, but this is all normal, when the transmitter is off the air. Now turn off the RF amplifier and the mod monitor. The frequency monitor stays on all the time.

General Guidelines for Operator use of the new Mt. Lincoln Transmitter

General Description:

Operation of the new stereo transmitter will be completely different from that of the old transmitter, so read this carefully, and if you have any question whatsoever, no matter how dumb it may sound, PLEASE ASK IT, to avoid any incorrect operation of the new set-up.

The new remote control will function not only to turn the transmitter on and off, but will also meter the important "operating constants" of the transmitter. These constants, along with the frequency monitor will have to be read hourly at first, then when things have settled down, maybe next year, readings will be every three hours.

Now that we are operating in stereo, we will have to, by law, swithh back to mono during portions of our broadcast which are mono (sports games, news, speeches, etc.), so everyone will have to know how to do that...its easily done.

We will also be using an Emergency Broadcast System receiver, and a later note will explain its operation.

The Remote Control: Introduction

The remote control has a large meter on the left side, with lots of different scales. IT IS IMPORTANT THAT ALL METER READINGS BE READ FROM THE PROPER SCALE, for obvious reasons, so pay attention to the instructions.

To the right of the meter is a row of 15 pushbuttons numbered 1 through 15 and one on the left side labelled "CAL". Each of the numbered pushbuttons connects the remote control to a specific function at the transmitter, so IT IS IMPORTANT TO HAVE THE CORRECT BUTTON PUSHED so as not to be reading filament voltage when you think you are reading plate current. A list of these is provided below and also is posted above the remote control. The "CAL" button is very important. For a multitude of reasons, THE REMOTE CONTROL MUST BE CALIBRATED EACH AND EVERE TIME A SERIES OF METER READINGS ARE TAKEN. The procedure for doing so is outlined in the next section.

On the bottom right, there are two buttons, one labelled "Raise" the other "lower". These are your control Buttons. They turn the filaments off and on, turn the plate on and off, raise and lower power, and switch you from mono to stereo and stereo to mono, depending on which of the numbered pushbutt ons you have pushed. The "RECYCLE" button has the following function: very occasionally the remote control at the transmitter will not register the command given it by the numbered pushbutton on the studio unit. In that case, you may get a false meter reading or no meter reading at all. If you are sure you have the right button pushed, hit the recycle button, and that shoudd help. If not, refer to the problems section of this note. The "READ" light should go off momentarily just after you push one of the numbered pushbuttons, but should quickly come back on, and must be on at all other times.

Calibration of the Remote Control:

You cannot get good meter readings if the remote control is out of calibration, so before each and every reading of the meters, calibration must be performed. This does not mean you must calibrate between reading plate voltage and plate current, for example, but once before the whole series of readings.

To calibrate, push the CAL button. The meter needle should rest exactly on zero--if not, adjust "ZERO ADJUST" until it does. Then push RAISE and hold it there. The meter needle should rise to mid-scale to lie right between the two little arrows on the very top of the meter...if not, adjust it so that it does with the CALIBRATE control,

4) After a few minutes (2 or 3), push position 1 on the remote control, wait for the read light, push LOWER and release. The meter should drop to zero and you're all done.

A note on the Frequency Monitor: When you turn the transmitter on or off the little "greater than 2" light may light up on the front panel of the frequency monitor. If it does, press the "reset" button and it should go away.

Putting the transmitter in mono:
1) Push button 5 on the remote control
2) press LOWER. The stereo light should go out and you are in left mono

Putting the transmitter back in stereo:
1) Push button 5 on the remote control.
2) Press RAISE. The stereo light on the mod monitor should come on and you are in stereo.

Remember: if you go into mono, you must log when you go into mono and when you go back to stereo in the transmitter log.

IN CASE OF DIFFICULTY: If something appears not to be working right, but does not look dangerous, try to figure it out yourself--i.e. check to see if all controls are in their proper positions as indicated by the +'s. If you cannot find anything wrong, immediately call one of the engineers:

David Carbone 253-9204 (303 Morrow) , or
Clay Harter 542-3176

If one of us is not available, start calling the E-board people until you reach one, and ask him. If something is actually not working right, every minute you delay may cost us our new transmitter.

If something appears to be very wrong with the transmitter, however, such as erratic meter indications, carrier going on and off by itself, hum and/or severe distortion, etc., quickly double check that you are looking at the right things, and then immediately kill the plate then the filaments of the transmitter.

If smoke or fire develops in the MCR, if you can localize the source to a specific piece of equipment, try to turn off its power if its switch is accessible, if not, try to use the fire extinguisher. If you cannot localize the source of the smoke/fire or if it is very extensive, leave the room, close the door, and if you can get into C corridor, throw the MCR power switch by the engineering table. ~~IF~~ Whether you can or not, call the fire dept, obviously, and then the enginmers and the general Manager.

On that somber note, I conclude this outline for operation of the new stereo transmitter. I don't pretend that I have remembered to include everything that might puzzle a non-engineer, but this should serve as a starting point for the training sessions, and again, if you have any questions whatsoever on the new set-up, please ask them.

5. the schedule columns. SI SCHED and PROG. SCHED are columns that should never be used by a human being for any information required by the FCC. It is provided by the computer so that the daily broadcast schedule is right at hand, when the computer is instructed to do so.

II. MAINTENANCE LOGS

Maintenance logs are the sole responsibility of the Chief Engineer and his appropriately licensed staff and are not kept on computerized log sheets or made available in the MCR.

III. TRANSMITTER LOGS

The transmitter log must include several items so that a complete account of the transmitter use at WAMH is made. The top of all transmitter logs has identification of the station, place, frequency, and date. The body of the log gives the time at which the transmitter is turned on or off, the times at which the transmitter begins to broadcast a program or ceases broadcasting a program, periodic readings of the transmitter power as required by the FCC, and comments about the broadcasts relevant to the FCC. The transmitter log includes also the name of each person who holds responsibility for the transmitter operation at all times while in use.

1. OPERATOR (ON + OFF). In this column belong all entries regarding the name of the single FCC-licensed individual who is officially on duty. When signing on, he must write: ((signature))on duty at _:__. The signature must be the same as that on his FCC license, which must be attached to the wall of the MCR. The sign-off is a parallel situation. Each signing-off must be immediately be followed in this column by the next person's signing-on, complete with the same time given as in the preceding signing-off. Thus there may never be a lapse of time when no one is signed on.

2. TIME, VOLTS, AMPS. In these columns are listed the periodic readings of transmitter potential and current. They are not required of ten-watt noncommercial educational FM radio stations by the FCC.

3. COMMENTS. In this column are listed the times at which the carrier to the transmitter is turned on and off, at which the program begins and ends, and at which miscellaneous pertinent incidents occur. The only correct way to log the turning on of the transmitter is: carrier on at _:__. The only correct way to log the start of programming is: program on at _:__. Obviously, the program cannot go on while the carrier is going on. Also obvious is that since the first program must be a sign-on, the Program Begin column entry in the program log must match the time of Program On in the transmitter log. A parallel method of logging is the case for sign-offs. Note also that the carrier cannot be turned on or off at any time when no one is signed on in the Operator column, since at such times the transmitter must remain off. Remember that if the last program is a sign-off, Program Off in the transmitter log must be entered one minute later, followed by Carrier Off, before the Operator Off may be logged.

GENERAL NOTES

Remember that the top of all logs must contain all information required by the FCC: call letters, frequency, channel, address, Log No., Date, and time zone. When the computer is called upon to print out all programs in the program log according to the dailysschedule, this is already complete. Otherwise, fill in the correct corredt date, then the log number within that date (in both cases crossing out the single digit remaining in those blank spaces because of the computer), and finally the time zone: EST is Eastern Standard Time (winter), EDST is Eastern Daylight Savings Time (summer).

Remember to co-ordinate the transmitter log with the program log, since they are printed on two halves of the same page. Remember to put "AM" or "PM" with the first time listed in these columns: SI, PROG. BEGIN, OPERATOR, and COMMENTS, and whenever it changes within a column.

WAMH-FM
AMHERST COLLEGE RADIO

Do not write inside

ELEMENT 1
SERIES "O" AND "M"

Question 1. Where and how are FCC licenses and permits obtained? (R&R 13.11(a))

Answer 1. An operator's license or permit may be obtained by applying for a specific license at a regional office of the Federal Communications Commission. An examination must then be taken by the applicant, and if the examination is completed satisfactorily, a license is then issued to the applicant. An applicant for a restricted radiotelephone permit must fill out an application, but he is not required to take an examination.

Q. 2. When a licensee qualifies for a higher grade of FCC license or permit, what happens to the lesser grade license? (R&R 13.26)

A. 2. If the holder of a license qualifies for a higher class in the same group, the license held will be cancelled upon the issuance of the new license. Similarly, if the holder of a restricted operator permit qualifies for a first- or second-class operator license of the corresponding type, the permit held will be cancelled upon issuance of the new license.

Q. 3. Who may apply for an FCC license? (R&R 13.5(a))

A. 3. Normally, commercial licenses are issued only to citizens and other nationals of the United States. As an exception, in the case of an alien who holds an Aircraft Pilot Certificate issued by the Civil Aeronautics Administration or the Federal Aviation Agency and is lawfully in the United States, the Commission, if it finds that the public interest will be served thereby, may waive the requirement of the U. S. nationality.

Q. 4. If a license or permit is lost what action must be taken by the operator? (R & R 13.71, 13.72)

A. 4. He must immediately notify the FCC, and may then apply for a duplicate license. He must inform the Federal Communications Commission of the circumstances surrounding the loss of the original license, or how said license was destroyed. He must state that a reasonable search has been made for the original license, and that if it is found subsequent to the issuance of a duplicate, he will return either the original or the duplicate to the FCC for cancellation. He also must submit documentary evidence of the service performed under the original license.

Pending receipt of the duplicate license, the operator may operate the station, but he must exhibit a signed copy of the application (FCC Form 756) for the duplicate license.

Q. 5. What is the usual license term for radio operators? (R & R 13.4(a))

A. 5. Commercial operator licenses will normally be issued for a term of five years from the date of issuance.

Q. 6. What government agency inspects radio stations in the U.S.? (Sec. 303(n))

A. 6. The Federal Communications Commission.

Q. 7. When may a license be renewed? (R & R 13.11)

A. 7. It may be renewed at any time during the final year of the license term or during a one-year period of grace after the date of expiration of the license sought to be renewed. This is done by submitting Form 756 to the nearest FCC field office. If the renewal application is submitted before the license expires, the operator may continue to operate. However, he must post a duplicate copy of the renewal application in lieu of the original license, since the original license must accompany the application. During the one year period of grace, the expired license is not valid until the new license has been issued.

Q. 8. Who keeps the station logs? (R & R 73.111)

A. 8. Each log shall be kept by the person or persons competent to do so, having actual knowledge of the facts required.

Q. 9. Who corrects errors in the station logs? (R & R 73.111)

A. 9. Any necessary correction may be made only by the person originating the entry.

Q. 10. How may errors in the station logs be corrected? (R & R 3.111)

A. 10. Any necessary correction may be made only by the person originating the entry who shall strike out the erroneous portion, initial the correction made, and indicate the date of correction.

Q. 11. Under what conditions may messages be rebroadcast? (Sec. 325(a))

A. 11. Messages may be rebroadcast only with the express authority of the originating station.

Q. 12. What messages and signals may not be transmitted? (R & R 13.66, 13.67, 13.68)

A. 12. No licensed radio operator shall transmit unnecessary, unidentified, or superfluous radio communications or signals. Neither shall he transmit communications containing obscene, indecent or profane words, language, or meaning. A licensed radio operator is prohibited from transmitting false or deceptive signals or communications by radio, or any call letter or signal which has not been assigned by proper authority to the radio station he is operating.

Q. 13. May an operator deliberately interfere with any radio communication or signal? (R & R 13.69)

A. 13. No.

Q. 14. What type of communication has top priority in the mobile service? (ART.)

A. 14. Distress calls, distress messages and distress traffic have top priority in the mobile service. Urgent signals are next in the order of priority, followed by safety signals.

Q. 15. What are the grounds for suspension of operator licenses? (Sec. 303(m)(1))

A. 15. The FCC may suspend an operator license upon proof sufficient to satisfy the Commission that the licensee:

(a) Has violated any provision of any Act, treaty or convention binding on the United States, which the Commission is authorized to administer, or any regulation made by the Commission under any such Act, treaty, or convention; or

(b) Has failed to carry out a lawful order of the master or person lawfully in charge of the ship or aircraft on which he is employed; or

(c) Has willfully damaged or permitted radio apparatus or installations to be damaged; or

(d) Has transmitted superfluous radio communications or signals or communications containing profane or obscene words, language, or meaning, or has knowingly transmitted ---

(1) False or deceptive signals or communications, or
(2) A call signal or letter which has not been assigned by proper authority to the station he is operating; or

(e) Has willfully or maliciously interfered with any other radio communications or signals; or

(f) Has obtained or attempted to obtain, or has assisted another to obtain or attempt to obtain, an operator's license by fraudulent means.

Q. 16. When may an operator divulge the contents of an intercepted message? (Sec. 605)

A. 16. An operator may divulge the contents of an intercepted message if the message is for the use of the general public or relating to ships in distress.

Q. 17. If a licensee is notified that he has violated an FCC rule or provision of the Communications Act of 1934, what must he do? (R & R 1.76)

A. 17. Within 10 days from receipt of notice, or such other period as may be specified, the licensee shall send a written answer, in duplicate, direct to the office of the Commission originating the official notice. If an answer cannot be sent or acknowledgment made within such 10-day period by reason of illness or other unavoidable circumstances, acknowledgment and answer shall be made at the earliest practicable date with a satisfactory explanation of the delay. The answer to each notice shall be complete in itself and shall not be abbreviated by reference to other communications or answers to other notices. In every instance, the answer shall contain a statement of action taken to correct the condition or omission complained of and to preclude its recurrence. In addition: (1) If the notice relates to violations that may be due to the physical or electrical characteristics of transmitting apparatus and any new apparatus is to be installed, the answer shall state the date such apparatus was ordered, the name of the manufacturer, and the promised date of delivery.

Q. 18. If a licensee receives a notice of suspension of his license, what must he do? (R & R 1.72)

A. 18. If a licensee receives a notice of suspension of his license, he must make a written application to the Commission within 15 days of receipt of the notice for a hearing on the suspension order.

Q. 19. What are the penalties provided for violating a provision of the Communications Act of 1934 or a Rule of the FCC? (Sec. 501, 502)

A. 19. Any person who willfully and knowingly violates the Communications Act of 1934 shall, upon conviction thereof, be punished for such offense, for which no penalty (other than a forfeiture) is provided in this Act, by a fine of not more than $10,000 or by imprisonment for a term not exceeding one year, or both; except that any person, having been once convicted of an offense punishable under this section, who is subsequently convicted of violating any provision of this Act punishable under this section, shall be punished by a fine of not more than $10,000 or by imprisonment for a term not exceeding two years; or both.

Any person who willfully and knowingly violates any rule, regulation or restriction made by the Commission under authority of this Act, or any rule, regulation or restriction made by any international communications treaty to which the United States is or may hereafter become a party, shall, in addition to any other penalties provided by law, be punished, upon conviction thereof, by a fine of not more than $500 for each and every day during which such offense occurs.

Q. 20. Define "harmful interference". (ART.)

A. 20. Harmful interference is any emission, radiation or induction which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunication service.

ELEMENT 2 — SERIES "O"

Ques. 1. What should an operator do when he leaves a transmitter unattended?

Ans. 1. Precautions should be taken so that the equipment will not be subjected to use by unauthorized personnel.

Q. 2. What are the meanings of: clear, out, over, roger, words twice, repeat, and break?

A. 2(a). "Clear" indicates that the transmission is completed, and that no response is expected.

(b) "Out" is similar in meaning to "clear". It indicates that the conversation is ended and no response is expected.

(c) "Over" indicates that the transmission has ended and a response is expected.

(d) "Roger" indicates that the immediately preceding message has been received, and is completely understood.

(e) "Words twice" is used to indicate that a series of words will be sent two times due to poor reception conditions or general communications difficulty.

(f) "Repeat" means to say again.

(g) The term "break" is used as a separation between parts of a single message.

Q. 3. How should a microphone be treated when used in noisy locations?

A. 3. It is good practice for the operator to shield the microphone with his hands when speaking into a microphone in a noisy location. This tends to cut down the microphone's picking up of background noise.

Q. 4. What may happen to the received signal when an operator has shouted into a microphone?

A. 4. Shouting into the microphone generally causes overmodulation. This results in speech distortion, as well as interference with stations on adjacent frequencies.

Q. 5. Why should radio transmitters be "off" when signals are not being transmitted?

A. 5. The transmitter should be off to prevent causing interference to other stations on the frequency.

Q. 6. Why should an operator use well-known words and phrases?

A. 6. Simple phrases and plain language are easier to understand. This reduces the number of errors that are made, and minimizes the amount of repetition necessary.

Q. 7. Why is the station's call sign transmitted?

A. 7. A station's call sign is transmitted so as to enable one to identify the station and thus avoid possible confusion. A proper station identification consists of the call letters and location of the station.

Q. 8. Where does an operator find specifications for obstruction marking and lighting (where required) for the antenna towers of a particular radio station?

A. 8. If an operator wishes to determine the specifications for obstruction marking and lighting of antenna towers, he should look in Part 17 of the Rules and Regulations of the FCC. If he wishes to determine the specifications for a particular station, he should examine the station authorization issued by the Commission.

Q. 9. What should an operator do if he hears profanity being used at his station?

A. 9. The licensed operator on duty should endeavor to end the transmission and should enter the relevant details in the log of the station. A report of the incident should be submitted to the FCC.

Q. 10. What should an operator do if the station he is calling does not answer within a reasonable length of time?

A. 10. He should stop calling and wait a reasonable length of time before attempting to call again. Continuous calling without results only causes interference and takes up valuable airways space that could be used by others.

Q. 11. When may an operator use his station without regard to certain provisions of his station license? (R & R 2.405)

A. 11. The licensee of any station, except amateur, may, during a period of emergency in which normal communication facilities are disrupted as a result of hurricane, flood, earthquake or similar disaster, utilize such station for emergency communication service in communicating in a manner other than that specified in the instrument of authorization: Provided: (a) That as soon as possible after the beginning of such emergency use, notice be sent to the Commission at Washington, D. C., and to the Engineer in Charge of the district in which the station is located, stating the nature of the emergency and the use to which the station is being put, and (b) That the emergency use of the station shall be discontinued as soon as substantially normal communication facilities are again available, and (c) That the Commission at Washington, D. C., and the Engineer in Charge shall be notified immediately

when such special use of the station is terminated.

Q. 12. Who bears the responsibility if an operator permits an unlicensed person to speak over his station?

A. 12. When a licensed operator in charge of a radiotelephone station permits another person to use the microphone and talk over the facilities of the station, he should remember that he continues to bear the responsibility for the proper operation of the station.

Q. 13. What is meant by a "phonetic alphabet" in radiotelephone communications?

A. 13. A phonetic alphabet is one in which a specific word is used to represent a letter of the alphabet; each letter has its corresponding word. For instance, the letter "A" may be made more easily recognizable by means of the word "Able", the word "Baker" is used to signify the letter "B", and the letter "C" is distinguished by use of the word "Charlie". By using one of the established phonetic symbols, the transmitting station makes clear to the receiving station exactly what letter is meant. This cuts down greatly on the amount of confusion and error, since many letters of the alphabet are similar in sound and may easily be confused.

Q. 14. How does the licensed operator of a station normally exhibit his authority to operate the station?

A. 14. An operator normally exhibits his authority to operate a station by posting a valid operator license or permit at the transmitter control point.

Q. 15. What precautions should be observed in testing a station on the air?

A. 15. In testing a radiotelephone transmitter, the operator should clearly indicate that he is testing, and the station call sign or name of the station, as required by the rules, should be clearly given. Tests should be as brief as possible. Caution should be observed by persons testing a station to make certain their test message will not interfere with other communications in progress on the same channel. Testing is important since it tells the operator whether the equipment is functioning properly. One of the primary duties of the operator is to maintain the equipment in proper operating condition.

ELEMENT 9

In recent years, Radiotelephone Third Class Operators with Broadcast Endorsements, have been given expanded privileges and duties. Some of these duties are somewhat technical in nature. To keep pace with these expanded duties, the FCC requires the Third Class Operator, with a Broadcast Endorsement, to have more technical knowledge than was previously required. The scope of the Element 9 examination has therefore been expanded to include additional technical and semi-technical questions.

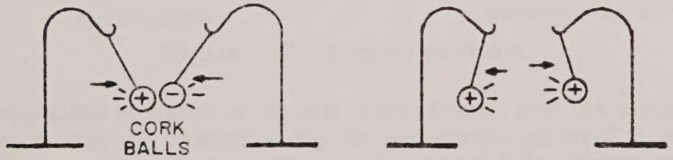
Previous editions of this book contained only the questions and answers given on Page 29. To meet the demand for the additional required knowledge, we are presenting the following basic information on radio theory. The prospective operator should be thoroughly familiar with the material contained in the questions and answers, as well as the basic radio theory.

The information in this book is sufficient for the prospective third class operator. However, if more technical information is desired, the AMECO "Commercial Radio Operator Theory Course" or "Radio Electronics Made Simple" publications can be consulted. These books are described on the back cover of this book.

BASIC RADIO THEORY

1-1 MATTER AND ELECTRICITY

Matter is a general term used to describe all the material things about us. Matter includes all man-made structures, woods, metals, gases, etc.; in other words, everything tangible. All matter, regardless of its size, quality or quantity, can be broken down fundamentally into two different types of particles. These particles, which are too small to be seen under a powerful microscope, are called ELECTRONS and PROTONS. Electrically, we say that the ELECTRON is NEGATIVELY charged and the PROTON is POSITIVELY charged. Also, the proton is about 1800 times as heavy as the electron.



A. Unlike charges attract. B. Like charges repel.

Figure 1-1. Attraction and repulsion.

1-2 THE LAW OF ELECTRIC CHARGES

Any object, such as a piece of glass, normally has a neutral or zero charge; that is, it contains as many electrons as protons. If this piece of glass can be made to have an excess of electrons, it is said to be negatively charged. Conversely, if the piece of glass can somehow be made to have a deficiency of electrons, the protons will predominate, and it is then said to be positively charged.

If a positively charged body is brought near a negatively charged body, the two objects will be drawn together. On the other hand, if two positively charged bodies or two negatively charged bodies are brought near each other, they will try to move away from each other. This reaction is the basis for our first law of electricity - the LAW OF ELECTRIC CHARGES. The law states "like charges repel, unlike charges attract". This law is illustrated by Figures 1-1A and 1-1B. In Figure 1-1A, a positively charged ball of cork is suspended by a piece of string near a negatively charged ball of cork. The two bodies swing toward each other since they attract each other. Figure 1-1B illustrates the two positively charged balls repelling each other.

1-3 DIFFERENCE OF POTENTIAL

If we were to connect a copper wire between the negative and the positive balls of cork, an electron flow would result. This is illustrated in Figure 1-2. The excess electrons from the negative ball would flow onto the positive ball where there is an electron deficiency and therefore, an attraction for the electrons. This flow continues until the deficiency and excess of electrons has disappeared and the balls become neutral or uncharged. This flow of electrons between the two differently charged bodies is caused by the difference in charge. A difference in charge between two objects will always result in the development of an electrical pressure between them. It is this electrical pressure that causes a current flow between these two bodies when they are connected by a piece of copper wire. This electrical pressure is defined as a DIFFERENCE OF POTENTIAL. The words "POTENTIAL" and "CHARGE" have similar meanings.

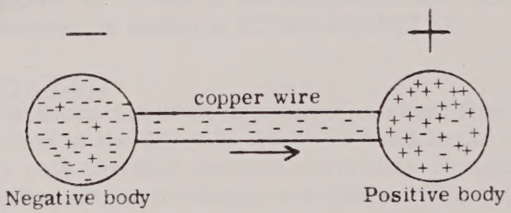


Figure 1-2. Flow of electrons.

1-4 CONDUCTORS AND INSULATORS

Materials through which current can easily flow are called CONDUCTORS. Most metals are good conductors. Conductors incorporate a large number of free electrons in their atomic structure. These free electrons are not held tightly and will move freely through the conductor when stimulated by external electrical pressure. Examples of good conductors, in the order of their conductivity, are silver, copper, aluminum and zinc.

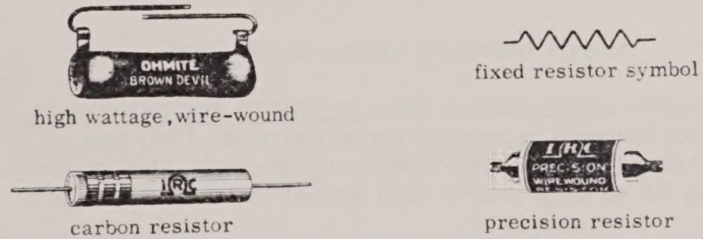
Those materials through which current flows with difficulty are called INSULATORS. The electrons are tightly held in the atomic structure of an insulator and, therefore, cannot move about as freely as in conductors. Examples of insulators are wood, silk, glass and bakelite.

1-5 RESISTANCE

The ability of a material to oppose the flow of current is called RESISTANCE. All materials exhibit a certain amount of resistance to current flow. In order to compare the resistances of various materials, we require some standard unit of resistance measurement. The unit of resistance that was adapted for this purpose was the OHM, and the Greek letter Ω is its symbol. 1 ohm is defined as the amount of resistance inherent in 1,000 feet of #10 copper wire. For example, 5,000 feet of #10 copper wire would have a resistance of 5 ohms, 10,000 feet of #10 copper wire would have 10 ohms, etc. Although the ohm is the basic unit, the MEGOHM, meaning 1,000,000 ohms, is frequently used. The instrument used to measure resistance is the OHMMETER.

1-6 RESISTORS

The resistor is a common radio part with a built-in specific amount of resistance. Resistors which are made of mixtures of carbon and clay are called carbon resistors. Carbon resistors are used in low power circuits. Wire wound resistors, which contain special resistance wire, are used in high power circuits. Figure 1-3 illustrates several types of fixed resistors which are used in radio circuits, together with the symbol which is used to represent them in circuit diagrams. When it becomes necessary to vary the amount of resistance in a circuit, we use adjustable and VARIABLE RESISTORS.



high wattage, wire-wound

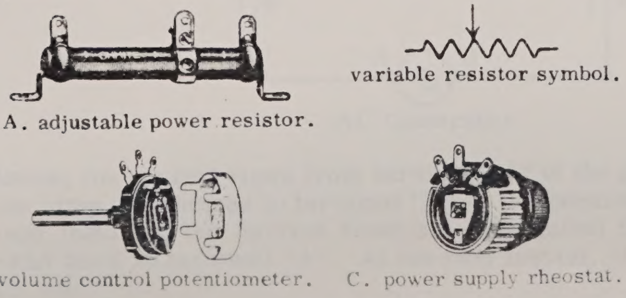
fixed resistor symbol

carbon resistor

precision resistor

Figure 1-3. Fixed resistors.

The adjustable resistor is usually wire-wound, and has a sliding collar which may be moved along the resistance element to select any desired resistance value. It is then clamped in place. Figure 1-4A shows an adjustable resistor.



A. adjustable power resistor.

variable resistor symbol.

B. volume control potentiometer.

C. power supply rheostat.

Figure 1-4. Variable resistors.

Variable resistors are used in a circuit when a resistance value must be changed frequently. Variable resistors are commonly called potentiometers or rheostats, depending upon their use. The resistance is varied by sliding a metal contact across the resistance in such a way so as to get different amounts of resistance. The volume control in a radio is a typical example of a variable resistor. Figure 1-4 B shows a potentiometer used as a volume control for a radio receiver; Figure 1-4 C shows a potentiometer wound of heavier wire for use in a power supply circuit.

1-7 VOLTAGE AND CURRENT

Voltage is another term for the difference of potential or electrical pressure which we spoke about in a preceding paragraph. It is the force which pushes or forces electrons through a wire, just as water pressure forces water through a pipe. Some other terms used to denote voltage are EMF (electro-motive force), IR DROP and FALL OF POTENTIAL. The unit of voltage is the VOLT and the instrument used to measure voltage is the VOLTMETER. The KILOVOLT is equal to 1000 volts.

Current is the flow of electrons through a wire as a result of the application of a difference of potential. If a larger amount of electrons flow past a given point in a specified amount of time, we have a greater current flow. The unit of current is the AMPERE; it is equal to 6,300,000,000,000,000,000 electrons flowing past a point in one second. MILLIAMPERE and MICROAMPERE are terms used to denote one-thousandth and one-millionth of an ampere, respectively. Current is measured by an AMMETER. A meter whose scale is in milliamperes is called a MILLIAMMETER, and a meter that reads microamperes is called a MICROAMMETER.

1-8 THE DRY CELL

Several methods are used to produce current flow or electricity. A common method is the dry cell, which is used in the ordinary flashlight. The dry cell contains several chemicals combined to cause a chemical reaction which produces a voltage. The voltage produced by all dry cells, regardless of size, is 1-1/2 volts. A battery is composed of a number of cells. Therefore, a battery may be 3 volts, 6 volts, 7-1/2 volts, etc., depending upon the number of cells it contains. The fact that a cell is larger than another one indicates that the larger cell is capable of delivering current for a longer period of time than the smaller one. Figure 1-5 illustrates a typical 1-1/2 volt cell and a 45 volt battery. The 45 volt battery contains 30 cells.

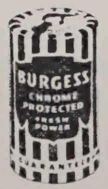


Fig. 1-5A. 1-1/2 v. flashlight cell.

BURGESS
BATTERY

Fig. 1-5B. 45 v. "B" battery.

Every cell has a negative and a positive terminal. The electrons leave the cell at the negative terminal, flow through the circuit, and return to the cell at the positive terminal. This type of current flow is known as DIRECT CURRENT (DC). Direct current flows only in ONE direction.

1-9 ELECTRICAL CIRCUITS

Figure 1-6 is a diagram of a complete electrical circuit. The arrows indicate the direction of the current flow. As long as we can trace the current from the negative point of the cell, all around the circuit and back to the positive point, we have a complete circuit. The important thing to remember is that current will only flow through a complete circuit.

The necessary parts for a complete circuit are:

(1) A source of voltage - the dry cell in Figure 1-6.
(2) Connecting leads - the copper wire conductors in Figure 1-6.
(3) A load - the bulb in Figure 1-6.

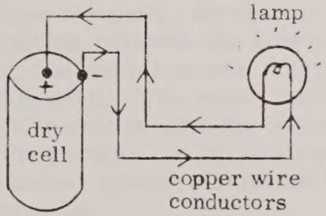


Fig. 1-6. Complete electrical circuit.

1-10 ALTERNATING CURRENT (AC) is completely different from direct current (DC). Whereas direct current is constant and flows in one direction only, alternating current continuously changes its direction. Fig. 1-7 shows an electric bulb hooked up to an AC generator.

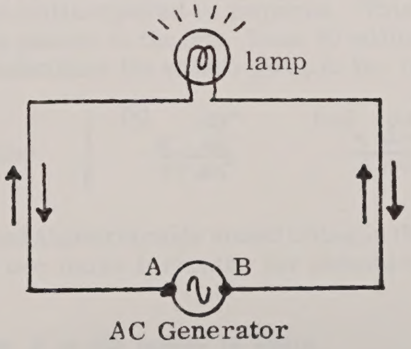


Figure 1-7.

At one instant, the current flows from terminal "A" of the generator, through the lamp and returns to terminal "B" of the generator. During the next instance, the current flows out of terminal B, through the lamp and back to terminal "A". At the next instant, it reverses itself, etc. etc.

Not only does alternating current reverse itself, as described above, it also continuously varies in strength from zero to some peak value. When an AC voltmeter reads AC voltage, it obviously does not read the instantaneous fluctuations; it reads its effective value.

Alternating current can be generated mechanically by an AC generator. It can also be generated by electronic means-by various tube and transistor circuits. Both AC and DC are present in a transmitter. However, the signal at the antenna that is to be transmitted is AC.

FREQUENCY. The flow of alternating current, first in one direction, then in the opposite direction, is called a complete "cycle". The frequency of alternating current is the number of complete cycles that occur in one second. The unit of frequency is cycles per second or simply cycles. The abbreviation for cycles per second is CPS. In recent years, the term "Hertz" (abbreviated "Hz"), has been used in place of cycles. The meter used to measure frequency is called a Frequency Meter.

The frequency of the AC power that is supplied to most homes in the United States is 60 Hertz. This is known as the POWER FREQUENCY. Radio waves transmitted by radio stations have a frequency much higher than the 60 Hz power frequency. Their frequency is generally above 20,000 Hz. An electrical frequency higher than 20,000 Hz is known as a RADIO FREQUENCY. The abbreviation for radio frequency is "RF".

Sound waves which can be heard by the human ear are called audible sounds or audio sounds. The frequency of the audio sounds lie in the range from 16 to 16, 000 Hz. When a sound wave frequency is converted into an electrical frequency, it is known as an audio frequency (AF). For example, when our voice is amplified by a public address system, the sound waves from our throats strike the microphone and are converted into electrical frequencies, or audio frequencies.

When a frequency is given as a large number of Hz, it can be converted into smaller units of kiloHertz per second or MegaHertz per second, just as pennies can be converted into dollars. Example:

(a) 1, 000 Hertz = 1 kiloHertz. The abbreviation for kiloHertz is "kHz". (The prefix kilo always means 1, 000). Therefore, in order to convert Hertz into kiloHertz, we divide the number of Hertz by 1, 000.

$$1,000,000 \text{ Hz} = \frac{1,000,000}{1,000} = 1,000 \text{ kHz}.$$

(b) 1, 000, 000 Hz = 1 MegaHertz. The abbreviation for MegaHertz is "MHz". Therefore, in order to convert Hertz into MegaHertz, we divide the number of Hertz by 1, 000, 000.

$$1,000,000 \text{ Hz} = \frac{1,000,000}{1,000,000} = 1 \text{ MHz}.$$

1-11 POWER

Whenever current flows through a resistance, there is friction

between the moving electrons and the molecules of the resistor. This friction causes heat to be generated, as does all friction. We could also say that electrical energy is changed to heat energy whenever current flows through a resistor. The unit of energy is the JOULE. The rate at which the heat energy is generated is the power that the resistor consumes. This power consumption in the form of heat represents a loss because we do not make use of the heat generated in radio circuits.

We should know how much heat power a resistor is consuming or dissipating. This is important because a resistor will burn up if it cannot stand the heat that is being generated by current flow. Resistors are, therefore, rated, not only in ohms, but in the amount of power that they can dissipate without overheating. The unit of electrical power is the WATT. A resistor rated at 5 watts is one which can safely dissipate up to 5 watts of power. If this resistor is forced to dissipate 10 watts, by increased current flow, it will burn up.

Exactly how much power is dissipated in a particular circuit, and upon what factors does the power dissipation depend? Since the power is the result of friction between the flowing electrons and the resistance in the circuit, the actual power dissipated depends upon the current and the resistance. The more current that flows, the more electrons there are to collide with the molecules of the resistance material. Also, the greater the resistance, the greater is the resulting friction. The actual power dissipated in a resistor can be found by the following formula:

$P = I^2 \times R$ where: P is the power in watts
(I^2 means I x I) I is the current in amperes
R is the resistance in ohms

Problem: Find the power dissipated in a 2000 ohm resistor with 50 milliamperes flowing through it.

Solution: First change milliamperes to amperes. This is done by moving the decimal three places to the left. Thus 50 milliamperes equals .05 ampere. Then substitute the values given in the formula.

(1) $P = I^2 \times R$
(2) $P = .05 \times .05 \times 2000$
(3) $P = 5$ watts

(1) $\begin{array}{r} .05 \\ \times\ .05 \\ \hline .0025 \end{array}$ (2) $\begin{array}{r} .0025 \\ \times\ 2000 \\ \hline 5.0000 \end{array}$

By using Ohm's law and algebraically substituting in the above formula, we can arrive at two more formulas for obtaining power dissipation.

$P = E \times I$ where: P is the power in watts,
$P = \frac{E^2}{R}$ E is the voltage in volts,
I is the current in amperes and
R is the resistance in ohms.

The Wattmeter is the instrument that is used to measure power. The Watt-hour meter is the instrument that is used to measure energy.

INTRODUCTION TO TRANSMISSION AND RECEPTION

The diagram in Figure 8 represents a bird's eye view of a complete communications system. Instead of drawing out the individual circuits, a series of boxes are drawn. Each box represents a stage. (A stage is a tube or transistor with its associated parts.) The function of each stage is printed inside the box. Such a diagram is known as a block diagram.

Fig. 8-A illustrates a block diagram of a radio-telephone transmitter. Let us see briefly what the function is of each stage outlined in the block diagram. The heart of the transmitter is the oscillator.

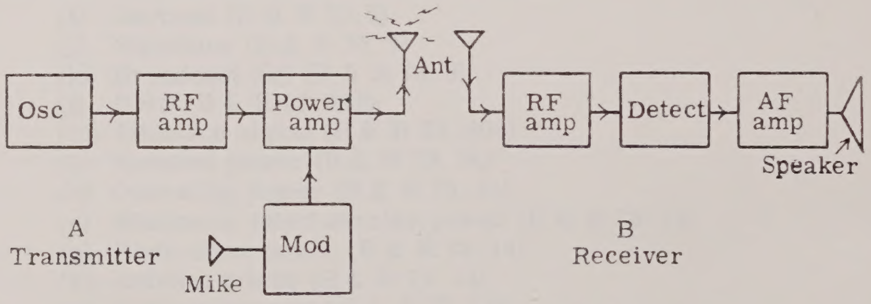


Figure 8. Radio transmitter and receiver.

Its sole purpose is to generate a high frequency alternating current. This high frequency AC is called radio frequency or RF. The output of the oscillator is fed to the radio frequency amplifier which simply amplifies the RF output from the oscillator. The output of the RF amplifier is then fed to the RF power amplifier. The RF power amplifier amplifies the RF in terms of power. The power amplifier then supplies the antenna with the RF power that is to be radiated into space. Up to this point, we have only discussed the generation and transmission of a radio frequency wave which, by itself, contains no intelligence. The intelligence that we desire to transmit is the audio in the form of voice or music. Let us see how the audio is radiated into space.

The function of the microphone is to convert sound energy into electrical energy. The output of the microphone is applied to the modulator, which is simply an audio amplifier. The modulator serves two functions: (1) it amplifies the weak audio output of the microphone and (2) it superimposes the audio onto the radio frequency energy that is present at the power amplifier stage, by a process called modulation. The audio is combined with the RF wave because an audio wave by itself is not capable of traveling through space. High frequency such as RF, however, is capable of traveling through space. Therefore, the RF acts as the "carrier" for the audio; the RF carries the audio from the transmitter to the receiver. The combined audio RF output of the power amplifier is fed to the antenna where it is radiated out into space in the form of electromagnetic waves.

At the receiving end of the communications system, the electro-

magnetic waves induce small voltages into the receiving antenna. These signal voltages are quite weak because the electromagnetic waves have travelled some distance before striking the receiving antenna. Therefore, the signal voltages must be amplified; this is the function of the first stage in the receiver called the RF amplifier. The output of this stage is applied to the detector. Just as the oscillator is the heart of the transmitter, the detector is the heart of the receiver. The detector stage separates the audio from the RF carrier. The carrier has served its purpose in bringing the audio to the receiver. Now, all we are interested in is the audio. The audio output of the detector is then fed to an audio amplifier stage to be amplified. The amplified audio is applied to a speaker which converts the audio electrical variations back into the original sound that energized the microphone of the transmitter.

ELEMENT 9*

Question 1. What is meant by the following words or phrases?
(a) Standard broadcast station (AM) (R & R 73.1)
(b) Standard broadcast band (R & R 73.2)
(c) Standard broadcast channel (R & R 73.3)
(d) FM station (R & R 73.310)
(e) FM band (R & R 73.310)
(f) FM Stereophonic Broadcast (R & R 73.310)
(g) FM Subsidiary Communications Authorization (SCA) (R & R 73.293)
(h) Sunrise and Sunset (R & R 73.8)
(i) Daytime (R & R 73.6)
(j) Nighttime (R & R 73.7)
(k) Broadcast day (R & R 73.9)
(l) EBS (R & R 73.912)
(m) Attention signal (R & R 73.906)
(n) Nominal power (R & R 73.14)
(o) Operating power (R & R 73.14)
(p) Maximum rated carrier power (R & R 73.14)
(q) Plate input power (R & R 73.14)
(r) Antenna power (R & R 73.14)
(s) Antenna current (R & R 73.14)
(t) Antenna resistance (R & R 73.14)
(u) Percentage modulation (amplitude) (R & R 73.14)

Answer 1(a). The term "standard broadcast station" (AM) means a broadcasting station licensed for the transmission of amplitude-modulated (voice type) emissions primarily intended to be received by the general public and operated on a channel in the band - 535 kiloHertz to 1605 kiloHertz.

(b) The term "standard broadcast band" means the band of frequencies between 535 kiloHertz and 1605 kiloHertz.

(c) The term "standard broadcast channel" means the band of frequencies occupied by the carrier and two side bands of a broadcast signal with the carrier frequency at the center. Channels shall be designated by their assigned carrier frequencies. The 107 carrier frequencies assigned to standard broadcast stations shall begin at 540 kiloHertz and be in successive steps of 10 kiloHertz.

(d) The term "FM station" means a station employing frequency modulation in the FM broadcast band and licensed primarily for the transmission of radiotelephone emissions intended to be received by the general public.

(e) The term "FM band" means the band of frequencies extending from 88 to 108 megaHertz, which includes those assigned to noncommercial educational broadcasting.

(f) The term "FM Stereophonic Broadcast" means the transmission of a stereophonic program by a single FM broadcast sta-

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*See note in Preface concerning Element 9 examination.

tion utilizing the main channel and a stereophonic subchannel.

(g) An "FM Subsidiary Communications Authorization" (SCA) is an authorization granted to an FM station for the simultaneous transmission of one or more signals on assigned subcarrier frequencies within the station's assigned channel. Special decoding equipment is required to receive program material furnished on the SCA subchannel. Such material, although broadcast related, is normally intended for paying subscribers.

(h) The terms "sunrise" and "sunset" mean, for each particular location and during any particular month, the time of sunrise and sunset as specified in the instrument of authorization. Specifying the times of sunrise and sunset on the station license is important because not all standard (AM) broadcast stations are permitted to operate at night. In order to control objectionable skywave interference, stations which are permitted to operate at night are frequently required to change their modes of operation. These changes may involve the use of directional antenna systems, a reduction in operating power, or both, and normally occur at the sunrise and sunset times, listed in the station license.

(i) The term "daytime" means the period of time between the local sunrise and the local sunset.

(j) The term "nighttime" means that period of time between local sunset and local sunrise.

(k) The term "broadcast day" means the period of time between local sunrise and 12 midnight, local standard time.

(l) "E B S" stands for Emergency Broadcast System. The Emergency Broadcast System consists of the facilities and personnel of nongovernment broadcast stations and interconnecting facilities which have been authorized by the Federal Communications Commission to operate in a controlled manner during a war, threat of war, state of public peril or disaster, or other national emergency.

(m) The "attention signal" is the signaling arrangement whereby standard, FM and television broadcast stations can actuate mute receivers for interstation receipt of emergency cueing announcements and broadcasts. It consists of two audio tones having fundamental frequencies of 853 and 960 Hertz and shall not vary over ±0.5 Hertz. The two tones, with specified frequency tolerances and harmonic distortion limits, modulate the transmitter simultaneously at no less than 40% for an automatic time period of not less than 20 seconds, nor longer than 25 seconds.

The total harmonic distortion of each of the audio tones shall not exceed 5%.

(n) "Nominal power" is the power of a standard broadcast station, as specified in a system of classification which includes the following values: 50 kW., 25 kW., 10 kW., 5 kW., 1 kW., 0.5 kW., 0.25 kW.

(o) Depending on the context within which it is employed, the term "operating power" may be synonymous with "nominal power" or "antenna power". The operating power for AM stations is normally the antenna input power and for FM stations, it is the transmitter output power.

(p) "Maximum rated carrier power" is the maximum power at which the transmitter can be operated satisfactorily, and is determined by the design of the transmitter and the type and number of vacuum tubes used in the last radio stage.

(q) "Plate input power" means the product of the direct plate voltage applied to the tubes in the last radio stage, and the total direct current flowing to the plates of these tubes, measured without modulation.

(r) "Antenna input power" or "antenna power" means the product of the square of the antenna current and the antenna resistance at the point where the current is measured.

(s) "Antenna current" means the radio-frequency current in the antenna with NO MODULATION.

(t) "Antenna resistance" means the total resistance of the transmitting antenna system at the operating frequency and at the point at which the antenna current is measured.

(u) "Percentage modulation" with respect to an amplitude modulated wave means the ratio of half the difference between the maximum and minimum amplitudes of the amplitude modulated wave to the average amplitude expressed in percentage.

Q. 2. Make the following transformations:

(a) Kilocycles to cycles.
(b) Kilovolts to volts.
(c) Milliamperes to amperes.
(d) Watts to kilowatts.

A. 2(a) One kilocycle (kc) is equal to 1,000 cycles (c). Therefore, in order to change kilocycles to cycles, we multiply by one thousand. In order to change cycles to kilocycles, we divide by one thousand. Examples: 3 kilocycles equals 3,000 cycles. 1.4 kilocycles equals 1,400 cycles. 500 cycles equals .5 kilocycle.

In recent years, the electronics industry has adopted the term "Hertz", abbreviated "Hz", to replace the term "cycles". Kilocycles has been replaced by "kiloHertz", abbreviated "kHz"; megacycles (meaning one million cycles), has been replaced by "MegaHertz", abbreviated "MHz".

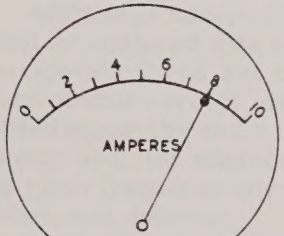
(b) One kilovolt is equal to 1,000 volts. Therefore, in order to change kilovolts (kv) to volts (v), we multiply by one thousand. In order to change volts to kilovolts, we divide by one thousand. Examples: 2.6 kilovolts equals 2,600 volts. 1 kilovolt equals 1,000 volts. 50 volts equals .050 kilovolt.

(c) One ampere is equal to 1,000 milliamperes. Therefore, in order to change milliamperes (ma.) to amperes (A), we divide by one thousand. In order to change amperes to milliamperes, we multiply by one thousand. Examples: 50 milliamperes equals .050 ampere. 200 milliamperes equals .2 ampere. .003 ampere equals

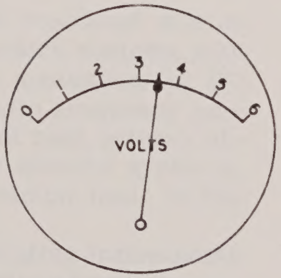
3 milliamperes.

(d) One kilowatt is equal to 1,000 watts. Therefore, in order to change watts to kilowatts, we divide by 1,000. In order to change kilowatts to watts, we multiply by 1,000. Examples: 3.4 kilowatts equals 3,400 watts. 250 watts equals .25 kilowatts.

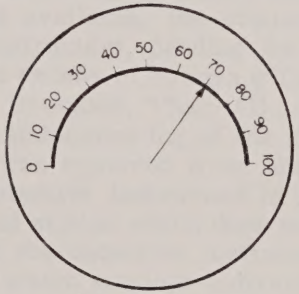
Q. 3. Draw the "face" of the following meters and know how to read each: (a) Ammeter. (b) Voltmeter. (c) Arbitrary scale meter. (d) Frequency monitor meter. (e) VU meter (for % modulation). (f) Milliammeter. (g) Antenna phase meter. (h) RF transmission line power meter.


0
2
4
6
8
10
AMPERES

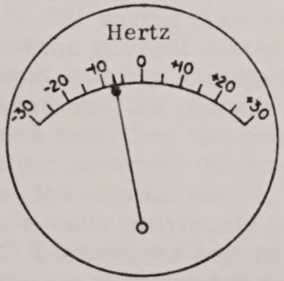
(a) Ammeter.
Reading shown
is 8 amperes.


0
1
2
3
4
5
6
VOLTS

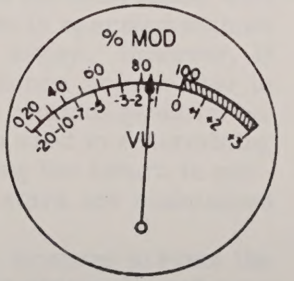
(b) Voltmeter.
Reading shown
is 3.5 volts.


0
10
20
30
40
50
60
70
80
90
100

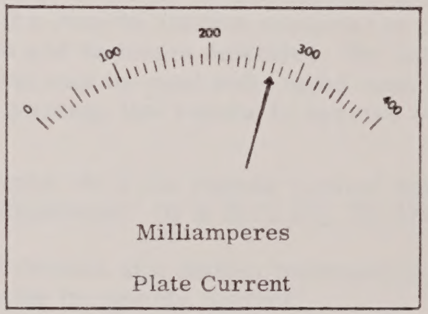
(c) Arbitrary
scale meter.


Hertz
-30
-20
-10
0
+10
+20
+30

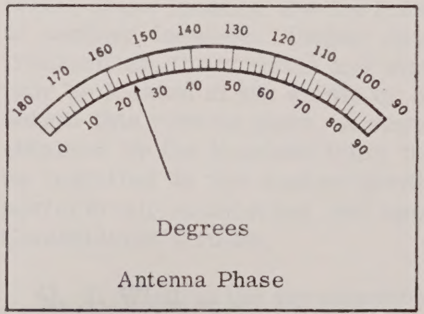
(d) Frequency Monitor
Meter indicates deviation in
Hertz. (kHz for FM stations)
Reading shown is -7 Hertz.


% MOD
0
20
40
60
80
100
-20
-10
-7
-5
-3
-2
-1
0
+1
+2
+3
VU

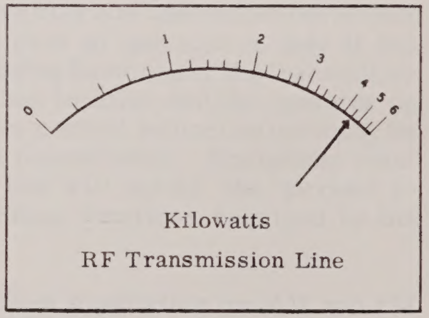
(e) VU Meter.
For % modulation, scale is
made larger than VU scale.
Reading shown is 85% mod.


0
100
200
300
400
Milliamperes
Plate Current

(f) Milliammeter.
Reading is 270 ma.


180
170
160
150
140
130
120
110
100
90
0
10
20
30
40
50
60
70
80
90
Degrees
Antenna Phase

(g) Antenna Phase Meter.
Reading on bottom scale
is 25 degrees.


0
1
2
3
4
5
6
Kilowatts
RF Transmission Line

(h) Transmission Line Wattmeter.
Reading is 4.5 kilowatts.

Q. 4. What indicating instruments are found in a broadcast transmitter? What should an operator know about these instruments? (R & R 73.39, 73.58, 73.258, 73.558)

A. Each transmitter is equipped with meters to indicate plate voltage and plate current. These meters indicate the operating constants of the transmitter amplifier. Each transmitter has normal operating levels of plate voltage and plate current and the operator should know what corrective actions should be taken when the meters indicate abnormal values.

At the place in the circuit where the antenna resistance or common point resistance is measured, an antenna ammeter is inserted to measure current into the antenna system. This meter is a direct indication as to whether the station is operating at, above, or below the licensed power. This meter indication should be maintained as close as possible to the licensed operating current and the operator should know what actions are necessary when the meter indications deviate from that value. Usually the antenna ammeter is located at the base of the tower and not easily accessible to the operator on duty. For this reason, most stations use a remote antenna ammeter which is located at the normal operating position of the person on duty. The remote antenna ammeter in-

dication may be entered in the operating log, in lieu of the base current meter indication, provided the remote meter is calibrated once weekly.

All antenna current meters should be read when the transmitter is not being modulated. A break in programs is a good time to read the antenna current meters.

Q. 5. What should an operator do if the remote antenna ammeter becomes defective? (R & R 73.58)

A. If the remote antenna ammeter becomes defective, the antenna base currents may be read and logged once daily for each mode of operation, pending the return to service of the regular remote meter.

Additional information: (a) Each standard broadcast station shall be equipped with indicating instruments (which conform with the specifications set forth in Sec. 73.39) for measuring the DC plate circuit current and voltage of the last radio frequency amplified stage; the radio frequency base current of each antenna element; and, for stations employing directional antenna systems, the radio frequency current at the point of common input to the directional antenna.

(b) In the event that any one of these indicating instruments becomes defective when no substitute which conforms with the required specifications is available, the station may be operated without the defective instrument, pending its repair or replacement, for a period not in excess of 60 days without further authority of the Commission: Provided, That: (1) Appropriate entries shall be made in the maintenance log of the station, showing the date and time the meter was removed from and actually restored to service. (3) If the defective instrument is the antenna current meter of a nondirectional station which does not employ a remote antenna ammeter, or if the defective instrument is the common point meter of a station which employs a directional antenna, and does not employ a remote common point meter, the operating power shall be determined by the indirect method (in accordance with Sec. 73.52) during the entire time the station is operated without the antenna current meter or common point meter. However, if a remote antenna ammeter or a remote common point meter is employed and the antenna current meter or common point meter becomes defective, the remote meter may be used in determining operating power by the direct method, pending the return to service of the regular meter, provided other meters are maintained at same value previously employed.

(c) If conditions beyond the control of the licensee prevent the restoration of the meter to service within the above allowed period, informal request (in accordance with Sec. 1.549) may be filed with the Engineer-in-Charge of the radio district in which the station is located, for such additional time as may be required to complete repairs of the defective instrument.

(d) Remote antenna ammeters and remote common point meters are not required; therefore, authority to operate without them is not necessary. However, if a remote antenna ammeter or common point meter is employed and becomes defective, the antenna base currents (as stated above) may be read and logged once daily for each mode of operation, pending the return to service of the regular remote meter.

Q. 6. What should an operator do if the remote control devices at a station so equipped malfunction? (R & R 73.67, 73.274 and 73.575)

A. If the remote control devices at a station malfunction, the operator should cease operating by remote control.

Additional Information: Some broadcast stations have the main studio at one location and the transmitter and associated equipment at another location. Rather than have an operator on duty at the transmitter, the controls and metering functions of the transmitter may be located at the studio or other location and the operator on duty at this control point. A remote control authorization must be obtained by the licensee from the Commission. Equipment must be installed at the control point that will permit the operator to perform all monitoring and operating functions required by the Commission's rules.

Q. 7. What is the permissible % of modulation for AM and FM stations? (R & R 73.55, 73.268, 73.568)

A. Modulation in excess of 100% is called overmodulation. It is to be avoided because it causes interference in AM and FM transmission. It also causes distortion in AM transmission.

A low percentage of modulation is called undermodulation. Undermodulation is undesirable because it results in weak reception.

In both AM and FM, the percentage of modulation shall be maintained as high as possible, consistent with good quality of transmission and good broadcast practice.

In a standard (AM) broadcast station, the percentage of modulation is not to exceed 100% on negative peaks of frequent recurrence, or 125% on positive peaks at any time.

In FM, the percentage of modulation is not to exceed 100% on either positive or negative peaks of frequent recurrence.

In both AM and FM, the percentage of modulation should not be less than 85% on peaks of frequent occurrence; but where necessary to avoid objectionable loudness, modulation may be reduced to whatever level is necessary, even if the resulting modulation is substantially less than 85% on peaks of frequent occurrence.

Q. 8. What is the station requirement with respect to station monitors? (R& R 73.50, 73.56, 73.253, 73.268, 73.553, 73.568)

A. Each station must have in operation a modulation monitor which the operator uses to determine whether the modulation is at

the proper level. The modulation monitor consists of a meter and a peak flasher. The meter does not indicate the peak modulation, but indicates a value somewhat less than the peak modulation. The "peak flasher" indicates modulation peaks. Generally, the peak flasher is set so that when it flashes, it is an indication that the modulation is excessive and that corrective action must be taken by the operator.

Q. 9. What is the permissible frequency tolerance of standard broadcast stations? (R & R 73.59) Of FM stations? (R & R 73.269)

A. The operating frequency of each AM broadcast station should be maintained within 20 Hertz of the assigned frequency. The center frequency of each FM broadcast station should be maintained within 2,000 Hertz of the assigned center frequency.

Q. 10(a) How is the operating power of a standard broadcast station determined? (R & R 73.51) (b) What is the operating power of a normally operating standard (AM) broadcast station having a final plate voltage of 800 volts, a final plate current of 1000 ma., an antenna resistance of 52 ohms, an antenna current of 3.2 amperes and an F factor of 0.7. (c) How is the operating power of an FM station determined? (R & R 73.267) (d) Using the indirect method, what is the operating power of the above transmitter?

A. (a) (1) Except as provided in paragraph (2) of this section, the operating power shall be determined by the direct method (the square of the antenna current times the antenna resistance at the point where the current is measured and at the operating frequency). For example, if the antenna current is 4.2 amperes and the antenna resistance is 48 ohms, the operating power is:

$$4.2^2 \times 48 = 4.2 \times 4.2 \times 48 = 846.7 \text{ watts}$$

Non-directional AM broadcast stations employ only a single antenna tower. Power determined by the direct method is equal to the product of the antenna resistance and the square of the antenna current. Directional AM broadcast stations employ multiple radiating elements. Power determined by the direct method for these stations is equal to the product of the resistance common to all antenna towers (common point resistance) and the square of the current common to all antenna towers (common point current). At FM broadcast stations, if power is determined by the direct method, it is read directly from the RF transmission line meter. This meter must be calibrated each six months to give a direct indication of the power supplied to the antenna.

(2) Operating power shall be determined on a temporary basis by the indirect method: (i) In the case of an emergency where the licensed antenna system has been damaged by causes beyond the control of the licensee (see Sec. 73.45), or (ii) Pending completion of authorized changes in the antenna system, or (iii) If any change is made in the antenna system or any other change is made which may affect the antenna system. (See Sec. 73.45).

In the indirect method, the operating power or antenna power is found by the formula:

$$P = E_p \times I_p \times F.$$

where: E_p = plate voltage of last stage in volts, I_p = total plate current of last stage in amperes and F = efficiency factor. The efficiency factor is either given by the transmitter manufacturer or by a table in the Rules and Regulations (73.51).

For example, the operating power of a transmitter (using the indirect method), having a plate voltage of 2.8 kv, a plate current of 850 ma. and an "F" factor of .65, is:

$$2800 \text{ V} \times .85 \text{ A} \times .65 = 1547 \text{ watts or } 1.547 \text{ kw.}$$

Note that the voltage must be in volts and the current must be in amperes in order to use the formula properly.

(b) Since the direct method must be used, we used the power formula involving the antenna current (I) and the antenna resistance (R):

$$P = I^2R = (3.2)^2 \times 52 = 3.2 \times 3.2 \times 52 = 532.5 \text{ watts.}$$

(c) The operating power of an FM station is determined by using either the direct or the indirect method. Using the direct method, the power is measured by an RF transmission line meter at the output terminals of the transmitter, while operating into a dummy load of substantially zero reactance and a resistance equal to the transmission line characteristic impedance. The indirect method used for FM stations is the same as that used for AM stations.

(d) Using the indirect method formula, we can find the operating power:

$$P = E_p \times I_p \times F = 800 \times 1 \times .7 = 560 \text{ watts.}$$

Q. 11(a) What stations may be operated by a third class broadcast operator and what equipment adjustments may they perform? (b) What should be the normal operating position of a radio operator? (R & R 73.93, 73.265, 73.565)

A. Except for a very limited number of standard broadcast stations, using critical directional antenna arrays, licensees of AM and FM broadcast stations may employ third class operators for the routine station operations. However, if a station licensee elects to use third class operators, he is subject to many additional requirements. In most cases, a supervisory operator holding a Radiotelephone First-Class Operator's license must be employed either on a full-time or part-time basis.

The third class operator privileges do not include operation of television stations.

With the exceptions set forth below, adjustments of the transmitting system, inspection, maintenance, repairs, required equipment performance measurements and required field strength measurements must be performed only by a first-class radiotelephone

operator.

Except at times when the operation of the station is under the immediate supervision of an operator holding a valid radiotelephone first-class operator license, adjustments of the transmitting equipment by a third class operator shall be limited to the following:

(1) Those necessary to turn the transmitter on and off.

(2) Adjustments of external controls as may be required to compensate for voltage fluctuations in the power supply.

(3) Adjustments of external controls to maintain modulation of the transmitter within the prescribed limits.

(4) Adjustments of external controls necessary to effect routine changes in operating power which are required by the station's instrument of authorization.

(5) Adjustments of external controls necessary to effect operation in accordance with a National Defense Emergency Authorization during an Emergency Action Condition.

(6) Those necessary to change between nondirectional and directional or between differing radiation patterns, provided that such changes require only activation of switches and do not involve the manual tuning of the transmitter final amplifier or antenna phasor equipment. The switching equipment shall be so arranged that the failure of any relay in the directional antenna system to activate properly will cause the emissions of the station to terminate.

It shall be the responsibility of the licensee to insure that the person who may be required to perform these tasks, as well as to perform other duties (such as reading meters and making log entries) is properly instructed so as to be capable of performing the duties required of him at times when not under the immediate supervision of a radiotelephone first-class operator. Where necessary, printed step-by-step instructions shall be posted for those transmitter adjustments which the lesser grade operator is authorized to make. Should the transmitting apparatus be observed to be operating in any manner inconsistent with this subpart or the current instrument of authorization for the station at any time when an operator holding a valid radiotelephone first-class operator license is not immediately available, and none of the above adjustments is effective in correcting the condition of improper operation, the emissions of the station shall be immediately terminated.

(b) One or more operators holding a radio operator license or permit of a grade specified in this section, shall be in actual charge of the transmitting system, and shall be on duty either at the transmitter location or at the remote control point. If operation by remote control has not been authorized, the transmitter, required monitors and other required metering equipment, shall be readily accessible and located sufficiently close to the operator at the normal operating position that deviations from normal indications of required instruments can be observed within a 360° arc

from that position. If operation by remote control is authorized, the required controls and instruments shall be readily accessible, and located sufficiently close to the operator at the normal operating position that deviations from normal indications of required metering instruments can be observed in a 360° arc from that position.

Q. 12. What are the power limitations on broadcast stations? (R & R 73.52)

A. The actual antenna input power of each station shall be maintained as near as is practicable to the authorized antenna input power and shall not be less than 90 percent nor greater than 105 percent of the authorized power; except that, if, in an emergency, it becomes technically impossible to operate with the authorized power, the station may be operated with reduced power for a period of 10 days, or less, without further authority from the Commission. If causes beyond the control of the permittee or licensee prevent restoration of authorized power within the allowed period, informal written request shall be made to the Commission in Washington, D. C., no later than the 10th day for such additional time as may be deemed necessary.

Noncommercial educational FM broadcast stations licensed to operate with transmitter output power of 10 watts or less, may be operated at less than the authorized power, but not more than 105 percent of the authorized power.

Q. 13. What logs must be kept by broadcast stations according to the Rules and Regulations of the FCC? (R & R 73.111)

A. The licensee or permittee of each standard broadcast station shall maintain program, operating and maintenance logs. The logs shall be kept in an orderly and legible manner, in suitable form, and in such detail that the data required for the particular class of station concerned is readily available. Time entries shall be either in local standard or daylight saving time and shall be indicated accordingly. Each log sheet shall be numbered and dated. No log or preprinted log or schedule which becomes a log, or portion thereof, shall be erased, obliterated, or willfully destroyed within the period of retention provided by the provision of this part. Any necessary correction shall be made only pursuant to Sections 73.112 and 73.113, and only by striking out the erroneous portion, or by making a corrective explanation on the log or attachment to it, as provided in those sections. Entries shall be made in the logs as required by Sections 73.112 and 73.113.

The operating log and the maintenance log may be kept individually on the same sheet in one common log, at the option of the permittee or licensee.

Q. 14. Who keeps the logs? (R & R 73.111)

A. Each log shall be kept by the station employee or employees (or contract operator) competent to do so, having actual knowledge of the facts required, who in the case of program and operating logs, shall sign the appropriate log when starting duty, and again when going off duty.

Q. 15. What entries are made in the program log? (R & R 73.112) In the operating log? (R & R 73.113)

A. The following entries shall be made in the program log:

(1) For each program: an entry identifying the program by name or title, an entry of the time each program begins and ends, an entry classifying each program as to type (news, religious, entertainment, sports), an entry classifying each program as to source, an entry for each program presenting a political candidate showing the name and political affiliation for such candidate.

(2) For commercial matter: an entry identifying the sponsor(s) of the program, the person(s) who paid for the announcement, or the person(s) who furnished materials or services of any kind (such as records, transcriptions, talent, scripts, etc.), an entry showing the total duration of commercial matter in each hourly time segment (beginning on the hour) or the duration of each commercial message (commercial continuity in sponsored programs, or commercial announcements) in each hour, and an entry showing that the appropriate announcements (sponsorship, furnishing material, or services, etc.) have been made. A check-mark (✓) will suffice but shall be made in such a way as to indicate the matter to which it relates.

(3) For Public service announcements: an entry showing that a public service announcement has been broadcast, together with the name of the organization or interest on whose behalf it has been made.

(4) For other announcements: an entry of the time that each station identification is made (call letters and licensed location), an entry for each announcement presenting a political candidate showing the name and political affiliation of such candidate, an entry showing that a mechanical reproduction announcement has been made. The licensee, whether employing manual or automatic logging, or a combination thereof, must be accurately able to furnish the Commission with all information required to be logged.

Manually kept log. Where, in any program log, or preprinted program log, or program schedule which upon completion is used as a program log, a correction is made before the person keeping the log has signed the log upon going off duty, such correction, no matter by whom made, shall be initialed by the person keeping the log prior to his signing of the log when going off duty, as attesting to the fact that the log, as corrected, is an accurate representation of what was broadcast. If corrections or additions are made on the log after it has been so signed, explanation must be made on the log or on an attachment to it, dated and signed by either the person who kept the log, the station program director or manager, or an officer of the licensee.

An FM station, operating under a Subsidiary Communications Authorization (SCA), should include in the log, at least once a day, a general description of the program content. Any changes in the program content and times of changes, should also be logged.

The following entries shall be made in the operating log by the properly licensed operator in actual charge of the transmitting apparatus, or by automatic devices. (See (b) below.)

(1) An entry of the time the station begins to supply power to the antenna and the time it stops. (2) See Answer 26.

(3) An entry at the beginning of operation in each mode and at intervals not exceeding three hours, of the following (actual readings observed prior to making any adjustments to the equipment) and, when appropriate, an indication of corrections made to restore parameters to normal operating values: (i) Operating constants of last radio stage (total plate voltage and plate current). (ii) Antenna current or common point current (if directional) without modulation.

(4) An entry each day of the following where applicable: (i) Antenna base current(s) without modulation for each mode of operation: (a) Where remote antenna meters or a remote common point meter are normally employed but are defective. (b) Where required by the station license for directional antenna operation. (ii) Where there is remote control operation of a directional antenna station, readings for each pattern taken at the transmitter (within two hours of commencement or operation with each pattern) of: (a) Common point current without modulation. (b) Base current(s) without modulation. (c) Phase monitor sample loop current(s) without modulation. (d) Phase indications.

(5) Any other entries required by the instrument of authorization or the provisions of this part.

(6) The entries required by Section 17.49 and (c) of this chapter. (b) Automatic devices accurately calibrated and with appropriate time, date and circuit functions may be utilized to record the entries in the operating log: Provided, That: (1) They do not affect the operation of circuits or accuracy of indicating instruments of the equipment being recorded; (2) The recording devices have an accuracy equivalent to the accuracy of the indicating instruments; (3) The calibration is checked against the original indicators at least once a week and the results noted in the maintenance log; (4) Provision is made to actuate automatically an aural alarm circuit located near the operator on duty, if any of the automatic log readings are not within the tolerances or other requirements specified in the rules or instrument of authorization; (5) Devices which record each parameter in sequence must read each parameter at least once during each 10-minute period and clearly indicate the parameter being recorded; (6) The automatic logging equipment is located at the remote control point if the transmitter

is remotely controlled, or at the transmitter location if the transmitter is manually controlled; (7) The automatic logging equipment is located in the near vicinity of the operator on duty and is inspected by him periodically during the broadcast day; and (8) The indicating equipment conforms with the requirements of Sec. 73.39 except that the scales need not exceed 2 inches in length and arbitrary scales may not be used.

Manually kept log. Any necessary corrections in a manually kept operating log shall be made only by the person making the original entry who shall make and initial each correction prior to signing the log when going off duty, in accordance with 73.111(a). If corrections or additions are made on the log after it has been so signed, explanation must be made on the log or on an attachment to it, dated and signed by either the operator who kept the log, the station technical supervisor or an officer of the licensee.

FM stations, using the direct method of determining power, log the RF transmission line meter reading rather than the antenna current, as in AM stations.

An FM station operating under a Subsidiary Communications Authorization must keep a log of its operation. The log may be included as part of the operating log for the main channel or may be kept separately. Entries are required of the time the subcarrier generator is turned on and when it is turned off (excluding subcarrier interruptions of 5 minutes or less). An entry is also required for the time modulation is applied to the subcarrier and the time the modulation is removed from the subcarrier.

FM broadcast stations with an operating power of 10 watts or less are only required to log the time the station begins to supply power to the antenna, the time it stops, and entries concerning the daily observations of tower lights.

Q. 16. When may abbreviations be used in the station's logs? (R & R 73.111)

A. Key letters or abbreviations may be used if proper meaning or explanation is contained elsewhere in the log.

Q. 17. How may a station's logs be corrected?(R & R 73.111).

A. Any necessary correction to a station's logs may be made by striking out the erroneous portion, initialing the correction made, and indicating the date of correction. Also, see Answer 15 above.

Q. 18. According to the Rules and Regulations of the FCC, how long must station logs be retained? (R & R 73.115)

A. Logs of standard broadcast stations shall be retained by the licensee or permittee for a period of two years: Provided, however, That logs involving communications incident to a disaster or which include communications incident to or involved in an investigation by the Commission and concerning which the licensee or permittee has been notified, shall be retained by the licensee or permittee until he is specifically authorized in writing by the Commission to destroy them: Provided, further, That logs incident to or involved in any claim or complaint of which the licensee or permittee has notice, shall be retained by the licensee or permittee until such claim or complaint has been fully satisfied, or until the same has been barred by statute limiting the time for the filing of suits upon such claims.

Q. 19. What information must be given to an FCC inspector at any reasonable hour? (R & R 73.116)

A. The following shall be made available upon request by an authorized representative of the FCC: (a) Program, operating and maintenance logs. (b) Equipment performance measurements required by Sec. 73.47. (c) Copy of most recent antenna resistance or common-point impedance measurements submitted to the Commission. (d) Copy of most recent field intensity measurements to establish performance of directional antennas required by Sec. 73.151.

The above information must be made available for inspection by representatives of the FCC at any reasonable hour.

Q. 20. What must be included in a station identification and how often is it given? (R & R 73.1201)

A. Station identification shall consist of the station's call letters, immediately followed by the name of the community or communities, specified in its license as the station's location.

These identification announcements must be made: (1) At the beginning (sign-on) and ending (sign-off) of each time of operation, and (2) hourly, as close to the hour as feasible, at a natural break in program offerings. Television broadcast stations may make these announcements visually or aurally. The only legal requirement for "sign-on" or "sign-off" is the correct station identification.

Q. 21. What should an operator do if the modulation monitor becomes defective? (R & R 73.56)

A. (a) Each station shall have in operation, either at the transmitter or at the place the transmitter is controlled, a modulation monitor of a type approved by the Commission. (b) In the event that the modulation monitor becomes defective, the station may be operated without the monitor, pending its repair or replacement, for a period not in excess of 60 days without further authority of the Commission: Provided, That: (1) Appropriate entries shall be made in the maintenance log of the station showing the date and time the monitor was removed from and restored to service. (3) The degree of modulation of the station shall be monitored with a cathode ray oscilloscope or other acceptable means.

Q. 22. When should minor corrections to the transmitter be made? Before or after logging the meter readings? (R & R 73.113)

A. Minor corrections to the transmitter should be made after

logging the meter readings.

Q. 23. What must a broadcast station do when it transmits matter for which it receives compensation? (R & R 73.119 and 73.289)

A. When a broadcast station transmits matter for which it receives or expects to receive any compensation such as money, services, or other consideration, the station must announce that the matter is sponsored or furnished and also announce the name of the sponsor. However, when a commercial product or service is advertised, use of the sponsor's corporate name, trade name, or name of the product or service will suffice if it is clear that the product name identifies the sponsor. Broadcast station licensees are responsible to insure that their employees or others connected with program material are fully aware that accurate sponsor identification must be obtained and broadcast. Sponsored programs and announcements that do not promote a specific commercial service or product must also be identified by the name of the actual sponsor. Operators keeping program logs must be alert to insure that sponsored matter is announced at the time of the broadcast and the sponsor is correctly identified in the program log.

Q. 24. When should an operator announce a program as "recorded? (R & R 73.1208)

A. Any taped, filmed or recorded program material in which time is of special significance, or by which an affirmative attempt is made to create the impression that it is occurring simultaneously with the broadcast, shall be announced at the beginning as taped, filmed or recorded. The language of the announcement shall be clear and in terms commonly understood by the public. For television stations, the announcement may be made visually or aurally.

Taped, filmed or recorded announcements which are of a commercial, promotional or public service nature, need not be identified as taped, filmed or recorded.

Q. 25. How often should the tower lights be checked for proper operation? (R & R 17.47 and 17.98)

A. Once each day, the operator is required to check for the proper operation of the tower lighting system. Most tower lighting systems are turned on and off with an automatic actuation switch controlled by a photocell. Stations using the photocell are required to burn the lights continuously if the automatic actuation switch does not operate properly. Any observed or otherwise known outage or improper functioning of a code or rotating beacon light or top light not corrected in 30 minutes should be reported by telephone or telegraph to the nearest Flight Service Station or office of the Federal Aviation Administration. Notice should also be given to the Flight Service Station or FAA office when the situation has been corrected.

Q. 26. What record is kept of tower light operation? (R & R 17.49)

A. The licensee of any radio station which has an antenna structure requiring illumination, shall make the following entries in the station record of the inspections:

(a) The time the tower lights are turned on and off each day, if manually controlled;

(b) The time the daily check of proper operation of the tower lights was made, if automatic alarm system is not provided;

(c) In the event of any observed or otherwise known failure of a tower light: (1) Nature of such failure. (2) Date and time the failure was observed, or otherwise noted. (3) Date, time and nature of the adjustments, repairs or replacements made. (4) Identification of Flight Service Station (Federal Aviation Agency) notified of the failure of any code or rotating beacon light or top light not corrected within 30 minutes, and the date and time such notice was given. (5) Date and time notice was given to the Flight Service Station (Federal Aviation Agency) that the required illumination was resumed.

(d) Upon completion of the periodic inspection required at least once each three months: (1) The date of the inspection and the condition of all tower lights and associated tower lighting control devices, indicators and alarm systems. (2) Any adjustments, replacements or repairs made to insure compliance with the lighting requirements, and the date such adjustments, replacements or repairs were made.

Q. 27. What is an Emergency Action Notification? (EAN) (R & R 73.907)

A. The Emergency Action Notification is the notice (with or without an Attack Warning) to all licensees and regulated services of the Federal Communications Commission and to the general public, of the existence of an Emergency Action Condition. The Emergency Action Notification is released upon direction of the President of the United States, and is disseminated only via the Emergency Action Notification System.

Q. 28. What is an Emergency Action Condition? (R & R 73.908)

A. An Emergency Action Condition is the condition which exists after the transmission of an Emergency Action Notification and before the transmission of the Emergency Action Termination. It is actually a national, state or local area emergency situation posing a threat to the safety of life or property.

Q. 29. What equipment must be installed in broadcast stations in regard to reception of an Emergency Action Notification? (R & R 73.933)

A. (a) All broadcast station licensees must install and oper-

ate, during their hours of broadcast operation, equipment capable of receiving Emergency Action Notifications or Terminations transmitted by other radio broadcast stations. This equipment must be maintained in operative condition, including arrangements for human listening watch or automatic alarm devices, and shall have its termination at each transmitter control point. However, where more than one broadcast transmitter is controlled from a common point by the same operator, only one set of equipment is required at that point.

(b) The off-the-air monitoring assignment of each standard, FM and television broadcast station is specified in the Detailed State Emergency Broadcast System (EBS) Operational Plan. Particular attention should be paid to avoiding "closed loops" in monitoring assignments.

(c) Prior to commencing routine operation or originating any emissions under program test, equipment test, experimental, or other authorizations or for any other purpose, licensees or permittees shall first ascertain whether an Emergency Action Condition exists and, if so, shall operate only in accordance with the Basic Emergency Broadcast System (EBS) Plan and Detailed State Emergency Broadcast System (EBS) Operational Plan.

Q. 30. How often should EBS test transmissions be sent? During what time period are they sent? (R & R 73.910, 73.961)

A. EBS test transmissions of the Emergency Action Notification System will be conducted by standard, FM and television broadcast stations once each week on an unscheduled basis, between the hours of 8:30 A.M. and local sunset. These tests will be conducted in accordance with procedures set forth in the EBS check list furnished to all broadcast stations.

Q. 31. During a period of an Emergency Action Condition, what should all non-participating stations do? (R & R 73.932(a))

A. Non-participating stations must observe radio silence.

Q. 32. (a) What is meant by the term "rebroadcast"? (b) What is the rule regarding the rebroadcasting of a program of another broadcasting station? (R & R 73.1207)

A. (a) The term "rebroadcast" means reception by radio of the programs of a radio station, and the simultaneous or subsequent retransmission of such programs by a broadcast station.

(b) No broadcasting station shall rebroadcast the program, or any part thereof, of another broadcasting station without the express authority of the originating station. A copy of the written consent, of the licensee originating the program shall be kept by the licensee of the station rebroadcasting such program, and shall be made available to the Commission upon request.

Q. 33. What are the rules with regard to broadcasting lottery information? (R & R 73.1211)

A. Broadcast stations are prohibited from transmitting announcements or programs promoting or containing information that would promote lotteries. A lottery is any scheme in which money or a prize of value is awarded to a person selected by lot or chance, if a condition of winning is that a person must have furnished any money, purchased a product or service, or have in his possession a product sold by the sponsor of a program broadcast on the station in question.

The provisions stated above do not apply to a lottery conducted by a State acting under authority of State law when such information is broadcast: (1) by a radio or television broadcast station licensed to a location in that State, or (2) by a radio or television broadcast station licensed to a location in an adjacent State which also conducts such a lottery. Such State "lottery" means the pooling of proceeds derived from the sale of tickets or chances and allotting those proceeds or parts thereof by chance to one or more chance takers or ticket purchasers. It does not include the placing or accepting of bets or wagers on sporting events or contests.

Q. 34. If a license or permit is lost, what action must be taken by the operator? What is the usual license term for radio operators? When may a license be renewed? (R & R 13.4, 13.11, 13.71 and 13.72)

A. See answers to Questions 4, 5 and 7 of Element 1, Series "O" and "M".

Q. 35. Where does an operator post his permit? (R& R 73.92, 73.264 and 73.564)

A. The operator must post his permit or posting statement at the place where he is on duty at the transmitter control point. FCC Form 759 is a posting statement used by operators employed at more than one station. The permit is posted at one station and FCC Forms 759 are posted at other stations where the operator is employed. The station license and other operating authorizations must be posted at the transmitter control point with all terms visible.

Q. 36. What is the rule regarding the broadcasting of a telephone conversation? (R & R 73.1206)

A. Before broadcasting a telephone conversation or recording a telephone conversation for later broadcast, the parties to the conversation must be informed of the intention to broadcast the conversation. However, station employees who may be presumed to be aware that their telephone conversations are intended for broadcast are not required to be advised of the broadcasting of their calls. Also, no notice of broadcast is required for per-

sons originating calls to programs which normally broadcast telephone conversations coming into the program.

Q. 37. What is a Subsidiary Communications Authorization? For what purpose is it used? (R & R 73.293, 73.295, 73.297, 73.593, 73.595 and 73.596)

A. A Subsidiary Communications Authorization (SCA) is a permit to use a subchannel within the main FM channel assignment.

In addition to monaural operation, FM stations may elect to broadcast stereo programming. This is accomplished by inserting a subchannel within the FM channel. In addition to the stereophonic subchannel, an entirely different subchannel may also be used. Programs transmitted by way of the Subsidiary Communications Authorization cannot be received without a special multiplex receiver. Most SCA subcarriers are used for the transmission of subscription background music, such as the music that is broadcast to stores and factories by Muzak. Other SCA uses are for detailed weather forecasting, special time signals, and other material of a broadcast nature expressly designed and intended for business, professional, educational, religious, trade, labor, agriculture or other groups engaged in any lawful activity.

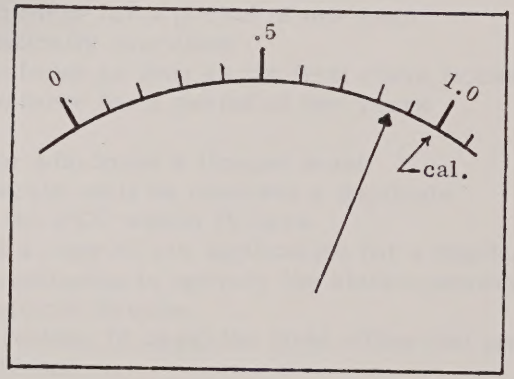
Q. 38(a) What is the basic difference between directional antenna systems and non-directional antenna systems? (b) How does the radio operator determine that a directional antenna is radiating according to a specified pattern? (c) Discuss phase differences and current ratios with respect to directional antenna systems. (R & R 73.69, 73.95)

A. (a) Non-directional AM stations use a single antenna tower and transmit the radio signal with equal strength in all directions from the station. Directional AM stations utilize more than one antenna tower. By establishing the position of each tower, the power radiated by each tower, and the phase of the signal in each tower, different signal strengths can be radiated in various directions. Directional antenna systems are used to improve the signal over desired areas and to reduce the signal in the direction of other stations to prevent interference.

(b) To determine if a directional antenna system is radiating the signal according to a specified radiation pattern, an instrument called an antenna monitor is installed at the station. The antenna monitor enables the operator to determine if the radio frequency (RF) current in each tower is of the correct value and if the phase of the signal radiated by each tower is also correct. Some antenna monitors indicate the ratio of current in each tower to the current in one tower called the reference tower.

(c) A radio frequency signal or current is actually an alternating current. In addition to reversing itself continuously, its actual instantaneous value is varying from zero to a certain amount. If the instantaneous peak values of the signals arrive at each tower at the exact same time, we say that the currents in each tower are "in phase" with each other. If the instantaneous peak values of the signals do NOT arrive at the towers at the exact same time, we say that the currents are "out of phase" with each other. The difference in time or phase is measured in degrees.

In most directional antenna systems, the currents in the various towers are out of phase with each other. The actual antenna currents (as read by ammeters), also tend to be different from each other. For each directional antenna tower, the station license contains a list of the required signal phases and antenna base current ratios. The antenna base current ratio for a tower is calculated by dividing the current meter reading for that tower by the current meter reading for the designated reference tower. The ratio, either calculated or read on the antenna monitor (see figure below), must not deviate more than 5 percent from the value on the station license. Operators on duty at AM stations, using directional antenna systems, should know how to read the antenna monitor meters, and should know how to use charts, tables or other instructions to determine if the station is operating correctly, if attention by the station's first class operator is required, or if the station must terminate operation.



Basic Antenna Current Ratio Meter.

The meter is set for "1.0" (cal.) by reading the current in the designated reference tower. The current is then taken for a given tower and its current ratio is then read on the meter. The meter can be in percentage or ratio. The above meter reads a ratio of .85.

FCC-TYPE EXAMINATION
ELEMENT 1

1. A response to a Notice of Violation must be made within:
   a. 10 days c. 3 days
   b. 24 hours d. 30 days

2. After receipt of a Notification of Suspension, the suspension order becomes effective within:
   a. 24 hours c. 3 days
   b. 30 days d. 15 days

3. The urgency signal is second in priority to:
   a. Communications relative to direction-finding bearings
   b. Communications preceded by a safety signal
   c. Distress calls, distress messages, and distress traffic
   d. Important international commerce bulletins

4. Corrections in the radio log may be made by:
   a. An operator licensed by the FCC
   b. The person who made the initial entry
   c. A notary public
   d. A person familiar with the operation of the installation

5. Radio stations are subject to inspection by:
   a. Any federal agency
   b. The Federal Bureau of Investigation
   c. The Federal Communications Commission
   d. The Federal Radio and Wire Authority

6. An application for renewal of a radio operator's license may be made:
   a. 15 months before expiration of the current license
   b. Within a year of expiration of the current license
   c. At all times, if there have been no violations
   d. Within 15 days of issuance of the original license

7. The secrecy provisions of the law do not apply to:
   a. Commercial bulletins
   b. Danish bulletins
   c. Holders of 1st Class Radiotelephone Operator's Licenses
   d. Distress messages

8. A response to a Notice of Violation must be addressed to:
   a. Any office of the Federal Communications Commission
   b. Any police authority of the continental United States
   c. The office of the FCC that originated the official notice
   d. The nearest Federal District Court

9. A person who has received an order of suspension may:
   a. Disregard the violation if he feels it to be unjust
   b. Request a hearing
   c. Order a court injunction on the FCC office
   d. Operate with an input power of less than 1 kilowatt

10. False signals of distress are:
    a. Allowed only if very low power is used
    b. Prohibited by law
    c. Common practical jokes among experienced operators
    d. Good tests of rescue facilities

11. Applicants for FCC licenses must generally be:
    a. Citizens of the United States only
    b. Citizens of the United States and Canada only
    c. Citizens of any country, provided they have held a radio operator's license of their respective country
    d. Citizens of English speaking countries

12. The usual license term for a radio operator is:
    a. one year c. three years
    b. two years d. five years

13. The second class radiotelephone license of a radio operator who qualifies for a first class license is:
    a. Kept in force for a period of one year
    b. Automatically cancelled
    c. Kept in force as long as the first class license is valid
    d. Kept in force for a period of two years

14. An operator who loses a license must:
    a. Not operate until he receives a duplicate
    b. Notify the FCC within 15 days
    c. Exhibit a copy of his application for a duplicate license while continuing to operate the station pending receipt of the duplicate license.
    d. Notify (within 10 days) the field office that issued the orginal license

15. Which of the following need not be done in correcting an error in a log:
    a. Indicate date of correction
    b. Indicate time of correction
    c. Initial the correction
    d. Strike out erroneous portion

16. Unidentified or superfluous radio communications may:
    a. Be transmitted on frequencies above 30 MHz.

- b. Not be transmitted at all
- c. Be transmitted on frequencies that are not used for distress, urgent or safety signals.
- d. None of the above

17. A person who willfully violates a provision of the Communications Act of 1934 faces a penalty of:
    - a. Not more than $500 fine
    - b. Not more than $10, 000 fine
    - c. Not more than $10, 000 fine and imprisonment for a term not exceeding one year
    - d. Not more than $5, 000 fine and imprisonment for a term not exceeding two years

18. Any person who knowingly violates a rule made by the Federal Communications Commission, shall, in addition to other penalties provided by law, receive a fine of not more than:
    - a. $500 for each day during which the offense occurs
    - b. $1000 for each day during which the offense occurs
    - c. $50 for each day during which the offense occurs
    - d. None of the above

19. A licensee who receives a notice that he has violated an FCC rule, must:
    - a. Send a written answer to the FCC in Washington, D. C. within 10 days.
    - b. Send a written answer to the FCC in Washington, D. C. within 15 days
    - c. Send a written answer to the FCC office originating the notice within 10 days.
    - d. Send a written answer to the FCC office originating the notice within 15 days.

20. The FCC may not suspend an operator license upon proof that the licensee:
    - a. Has failed to carry out a lawful order of the master of the ship on which he is employed.
    - b. Has transmitted superfluous radio communications
    - c. Has assisted another to obtain an operator's license by fraudulent means
    - d. None of the above

FCC-TYPE EXAMINATION

ELEMENT 2—SERIES "O"

1. The word "OVER" indicates:
    - a. The conclusion of a series of transmissions
    - b. The station is leaving the air temporarily
    - c. The transmission is over and no response is expected
    - d. The transmission is over and a reply is expected

2. The system of substituting words for corresponding letters is known as:
    - a. The Dewey system
    - b. The substitute transmission method
    - c. The phonetic system
    - d. The safety-sending method

3. The word "OUT" means:
    - a. The station is being interfered with
    - b. The station is leaving the air
    - c. The transmission is ended and a response is expected
    - d. The transmission is concluded and no response is expected

4. Shouting into a microphone may cause:
    - a. Deattenuation
    - b. Amplification
    - c. Rectification
    - d. Overmodulation

5. When speaking into a microphone in a noisy location, it is good practice to:
    - a. Shield the microphone with the hands
    - b. Shout directly into the microphone
    - c. Turn down the audio gain control
    - d. Speak very softly

6. Unnecessary calling should be avoided since it may cause:
    - a. Overmodulation
    - b. Interference with other stations
    - c. Electro-magnetic decoupling
    - d. Antenna wear

7. In radiotelephony, the words "READ BACK" mean:
    - a. I am repeating my previous transmission
    - b. This transmission is being read
    - c. Repeat the entire message back to me exactly as you have received it
    - d. This is a "copied" transmission, not an original reading;

8. A separation between portions of a single transmission should be indicated by inserting the word:
   a. SEPARATE
   b. STOP
   c. BREAK
   d. SECURITY

9. The licensed operator of a ship's radiotelephone station exhibits his authority to operate by:
   a. Wearing a lapel pin with his registration number
   b. Printing circulars with his qualifications stated plainly
   c. Demonstrating proficiency in reception of American Morse Code
   d. Posting his license conspicuously at the principal location of the station

10. All calling should be:
    a. Lengthy and detailed
    b. Done on working frequencies
    c. Clear and concise
    d. Repeated several times

11. When voice transmissions are not being made, the transmitter should be:
    a. Dismantled
    b. Moved away from windows, air vents, etc.
    c. Kept on the air
    d. Kept off the air

12. If an operator is told that his voice is distorting, he should:
    a. Speak more softly or back away from the microphone
    b. Report the insult to the FCC
    c. Dismantle the modulator immediately
    d. Use A1 emission promptly

13. An operator will find specifications for obstruction marking and lighting for antenna towers in:
    a. The Communications Act of 1934
    b. Part 17 of the FCC Rules and Regulations
    c. The Geneva Radio Regulations of 1934
    d. The bulletins issued by the nearest FCC office

14. In the event of an emergency, an operator may:
    a. Increase his power in excess of the amount specified in the instrument of authorization
    b. Utilize his station in a manner other than that specified in the instrument of authorization
    c. Not utilize his station at all
    d. Transmit on frequencies other than those specified in the instrument of authorization

15. When a person other than the licensed operator speaks into a microphone, responsibility for proper operation of the station is borne by:
    a. The owner of the station
    b. The licensed operator in charge of the station
    c. The person himself, provided he is over 21 years of age
    d. The person himself, provided he is over 18 years of age

16. In radiotelephone communications, a common expression "Repeat" means:
    a. Speak slower
    b. Say again
    c. Repeat twice
    d. Use the phonetic alphabet

17. An operator who leaves his station unattended in a public place:
    a. Is not responsible for the transmitter when he is not present
    b. Must make it inaccessible to unauthorized persons
    c. Must always leave another licensed operator with the transmitter during daytime hours
    d. Must turn the transmitter off

18. An operator who hears profanity being used at his station need not:
    a. End the transmission
    b. Enter relevant details into the log
    c. Repeat the incident to the FCC
    d. Personally order a citizens arrest of the person uttering the profanity.

19. The word "Clear" when used in radiotelephone indicates that:
    a. The transmission is completed and no response is expected
    b. The immediately preceding message has been received and is completely understood
    c. The transmission is completed and a response is expected
    d. The next message has nothing to do with the previous message.

20. In testing a radiotelephone transmitter, an operator should not:
    a. Clearly indicate that he is testing
    b. Give the station call sign
    c. Interfere with other communications
    d. Test for as short a time as possible

FCC-TYPE EXAMINATION
ELEMENT 9

1. The percentage of modulation on negative peaks of frequent recurrence in an FM transmitter must not be more than:
   a. 50%   c. 85%
   b. 75%   d. 100%

2. 18 milliamperes is equal to:
   a. 18000 amperes   c. 1.8 amperes
   b. .018 amperes   d. .18 amperes

3. Using the indirect method, what is the operating power of a transmitter with an efficiency factor of 0.65, whose last RF stage has a plate voltage of 850 volts and a plate current of 60 ma.
   a. 33 watts   c. 51 watts
   b. 33, 150 watts   d. 51, 000 watts

4. Abbreviations may be used in a log:
   a. Only if the operator holds a first class radiotelephone license
   b. Only if they are approved FCC-type abbreviations
   c. If proper meaning or explanation is given elsewhere in the log
   d. Abbreviations may not be used in a log.

5. Corrections in a manually kept operating log may be made:
   a. only by the person making the original entry
   b. By persons competent to do so, having actual knowledge of the facts
   c. Only by the person in charge of the station
   d. Corrections may not be made in a log

6. Station logs must be retained for a period of:
   a. 1 year   c. 3 years
   b. 2 years   d. 5 years

7. Logs pertaining to communications involving a disaster must be retained for a period of:
   a. 2 years   c. 5 years
   b. 3 years   d. until authorized by the FCC to destroy them

8. The following must be included in a station identification:
   a. Call letters and location.
   b. Call letters.

c. Call letters, location and time.
d. Call letters and time.

9. In general, station identification must be made:
a. At the beginning and end of each time of operation.
b. Every 15 minutes.
c. Every 30 minutes.
d. At the beginning and end of each time of operation and hourly, as close to the hour as feasible during a natural break in the program.

10. The Standard Broadcast Band refers to the band of frequencies from:
a. 500 kHz to 1600 kHz.
b. 535 kHz to 1605 kHz.
c. 88 MHz to 108 MHz.
d. 550 kHz to 1700 kHz.

11. An operator must announce that a recorded program is in fact recorded:
a. If the program lasts at least one half minute.
b. Even if it is obvious to all that the program is recorded.
c. If an attempt is made to create the impression that it is occurring simultaneously with the broadcast.
d. An announcer need not indicate the fact that a particular program is recorded.

12. E B S stands for:
a. Emergency Broadcast System.
b. Energy Broadband System.
c. Electronic Broadcast Service.
d. None of the above.

13. E B S test transmissions should be sent at least:
a. Once a week.
b. Once a month.
c. Once each day.
d. Twice a week.

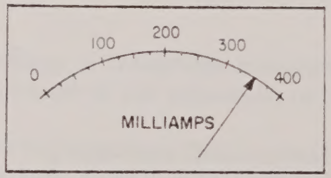
14. During a period of an Emergency Action Condition, non-participating stations:
a. Must continue their usual activity.
b. Must observe radio silence.
c. Must monitor specific stations.
d. Must keep their carriers on but stop modulation.

15. Tower lights shall be checked:
a. At least once each week.
b. At the beginning and end of each days activities.
c. At exactly one hour after sunset.
d. At least once each day.

16. If the tower lights fail, the operator must immediately notify the nearest:
a. Federal Aviation Agency office
b. Civil Air Patrol office
c. FCC office
d. E B S station

17. Which of the following exceeds the power limitations for a 25 kw. broadcast station?
a. 25.900 kw.
b. 23 kw.
c. 22, 600 watts
d. 26, 300 watts

18. The meter reads:
a. 350 amperes
b. 3.5 milliamperes
c. .35 amperes
d. 35 amperes



19. In making a log correction, the erroneous portion must be struck out, the corrections made, and:
a. the correction must be initialed.
b. the correction must be initialed and the date of correction must be entered.
c. the bottom of each page where corrections are made must be signed by the operator making the corrections.
d. slight corrections need not be initialed.

20. In the event of a malfunction of a part of the remote control equipment, the licensee:
a. must notify the nearest FCC office.
b. may operate for a period of 24 hours while repairs are being made.
c. must cease operation by remote control.
d. none of the above.

21. Using the direct method, what is the power of a broadcast station whose antenna resistance is 55 ohms, plate voltage of final stage is 2, 000 volts, plate current of final stage is 800 ma., antenna current is 5 A.?
a. 10, 000 W.
b. 1280 W.
c. 1600 W.
d. 1375 W.

22. If the antenna base current ratio of an antenna tower (tower 1) is .4 and the base current of the reference tower (tower 2) is 5 amperes, what is the antenna base current in tower 1?
a. 0.8 A.
b. 2 A.
c. 1.25 A.
d. 12.5 A.

23. Operator licenses may not be renewed:
a. during the final year of the license term.
b. within a year after the expiration of the license.
c. during the last two years of the license term.
d. none of the above.

24. A three -tower antenna system would be used at a:
a. non-directional station c. omnidirectional station
b. directional station d. tri-directional station

25. A "peak flasher" is used to indicate:
a. modulation peaks c. large frequency errors
b. current peaks d. excessive power

26. 850 volts is the same as:
a. 8, 500 kilovolts c. 850, 000 kilovolts
b. 0.85 kilovolts d. 8.5 kilovolts

27. What must an operator do if he notices an improper reading due to a malfunction of the remote control equipment?
a. he must cease operating.
b. he must switch his mode of operation.
c. he must reduce his power until the malfunction is corrected.
d. he must cease operating by remote control.

28. Where must an operator post his operator permit if he is employed at more than one station?
a. at his principal place of employment.
b. he need only post his permit at a station where he is the chief operator.
c. he must post his permit or special form at all stations where he is employed.
d. his permit must be kept in his possession at all times.

29. Programs transmitted by way of the Subsidiary Communications Authorization:
a. must be received with a special multiplex receiver.
b. are used only for the transmission of music.
c. make use of a subchannel inserted 25 kHz outside the main FM channel assignment.
d. must use monaural operation.

30. A broadcast station may transmit announcements promoting lotteries, provided:
a. the sponsor is not a profit-making organization.
b. the sponsor is a religious or fraternal organization.
c. the selection of the lottery winner is carefully supervised.
d. a broadcast station may not transmit announcements promoting lotteries.

31. When a commercial product is advertised, how must the sponsor be identified?
a. by his corporate name. b. by his trade name.
c. by the product name.
d. by any of the above, provided it is clear who the sponsor is.

32. An 8 watt FM broadcast station is required to log:
a. the plate voltage and current of the final stage.
b. the daily observations of the tower lights.
c. the antenna base current.
d. RF transmission line base reading.

33. If an operator's license is lost:
a. he must cease operating until his new license is received.
b. he must apply for a new license on FCC Form 736.
c. a copy of his duplicate license application must be posted.
d. he may continue to operate until his original license would have expired.

34. With regard to the broadcasting of telephone conversations:
a. all parties must be informed of the intention to broadcast their calls.
b. persons originating calls to programs that normally broadcast telephone conversations need not be notified.
c. only station employees need not be notified.
d. no one need be notified if the station is broadcasting to the general public.

35. Directional antenna systems do not generally:
a. reduce interference. b. use several towers.
c. have the currents in each tower in phase with each other.
d. increase the signal strength in the desired area.

36. What is the antenna base current ratio of an antenna tower if its base current is 7 amperes and the antenna base current in the reference tower is 4 amperes?
a. .57 b. 28 c. 1.75 d. 2.8

37. Using the indirect method, what is the operating power of a broadcast station if the plate voltage of the last stage is 1500 volts, plate current is 700 ma., and efficiency factor is .7?
a. 1050 watts b. 735 watts c. 105 watts d. 7350 watts

38. 3.75 kilowatts are equal to:
a. 375 watts c. 0.0375 watts
b. 37.5 watts d. 3, 750 watts

39. A third class operator with a broadcast endorsement may make repairs to:
a. prevent voltage fluctuations in the primary power supply.
b. correct directional antenna malfunction.
c. the antenna phasor equipment. d. none of the above

40. If the operation of a transmitter is by remote control, what percentage of the remote controls and instruments must be readily accessible?
a. 50% b. 100% c. 75%
d. 100% of those dealing with power and frequency.

ANSWERS TO FCC-TYPE EXAMINATIONS

ELEMENT 1

1. a
2. d
3. c
4. b
5. c
6. b
7. d
8. c
9. b
10. b
11. a
12. d
13. b
14. c
15. b
16. b
17. c
18. a
19. c
20. d

ELEMENT 2—SERIES "O"

1. d
2. c
3. d
4. d
5. a
6. b
7. c
8. c
9. d
10. c
11. d
12. a
13. b
14. b
15. b
16. b
17. b
18. d
19. a
20. c

ELEMENT 2—SERIES "M"

1. d
2. d
3. b
4. b
5. a
6. b
7. a
8. b
9. a
10. d
11. b
12. c
13. c
14. c
15. c
16. d
17. d
18. b
19. b
20. a

ELEMENT 9

1. d
2. b
3. a
4. c
5. a
6. b
7. d
8. a
9. d
10. b
11. c
12. a
13. a
14. b
15. d
16. a
17. d
18. c
19. b
20. c
21. d
22. b
23. c
24. b
25. a
26. b
27. d
28. c
29. a
30. d
31. d
32. b
33. c
34. b
35. c
36. c
37. b
38. d
39. d
40. b